LANDS DIRECTORATE

DIRECTION GENERALE DES TERRES

# THE AGRICULTURE - FOREST INTERFACE

## AN OVERVIEW OF LAND USE CHANGE

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# THE AGRICULTURE-FOREST INTERFACE:

# AN OVERVIEW OF LAND USE CHANGE

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## PREFACE

This working paper reports on the current status of knowledge concerning the extent, causes and consequences of land use change on the agriculture-forest interface across Canada. The report is one of the series of both overview and indepth case studies by Lands Directorate which have documented the magnitude, the underlying causes and implications as well as the policy responses to changes on lands of environmental and economic importance to Canada. Research has included studies of the agricultural heartland, the agricultural margins, fruitlands, wetlands, forest lands and energy lands.

## ABSTRACT

The agriculture-forest interface is defined as the general boundary zone separating the agricultural ecumene from forest. A variety of land uses in addition to farming and forestry can exist in such areas: recreation, energy and mineral development, wildlife, watershed protection. This exploratory paper reviews, by province, the principal geographic areas of substantial recent changes in land use at the agriculture-forest interface and discusses the land allocation and management issues associated with each area. Information for the regional survey was obtained from both a bibliographic search and a nationwide questionnaire survey administered to researchers and planners concerned with land resource management. Data sources appropriate to further study of the nature, causes and consequences of land use change and conflict in the zone are discussed and a strategy for further study, combining both a national overview approach and a case study approach, is recommended. For those who wish to pursue this field of study, detailed descriptions of the quantitative data bases identified and brief annotations of both land planning/management reports and other published sources are appended to the report.

## RÉSUMÉ

La zone agro-forestière est la zone contact séparant l'écoumène agricole de la forêt. Une gamme d'activités s'ajoutant aux utilisations agricole et forestière peuvent exister dans cette zone: activités récréatives, exploitation énergétique et minière, habitats fauniques, protection de bassins hydrographiques. Cette étude explore, par province, les principales régions où se sont produits récemment d'importants changements d'utilisation des terres dans la zone agro-forestière. On y discute des problèmes liés à l'affectation et la gestion des terres. L'information employée pour les analyses régionales a comme source une recherche bibliographique, accompagnée d'un questionnaire national qui s'adressait à des chercheurs et planificateurs intéressés à la gestion de la ressource foncière. Finalement, les auteurs suggèrent des sources de données additionnelles afin de poursuivre l'étude des changements d'utilisation des terres dans la zone agro-forestière et recommandent l'adoption d'une approche méthodologique incluant une perspective nationale ainsi que des études-types. Quiconque désirant poursuivre ce champ d'étude trouvera en annexe une description détaillée des banques de données quantitatives identifiées au cours de cette étude de même que de brèves annotations portant sur les rapports de planification et de gestion de même que d'autres sources pertinentes.

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The authors also extend their appreciation to the nearly 100 land resource professionals from government agencies, crown corporations, academic institutions and public interest groups across Canada who provided much information and assistance about land issues and data sources on the agriculture-forest interface, through questionnaire responses and personal interviews.

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## 1.0 INTRODUCTION

Since the Second World War, substantial changes in land use have occurred along the edge of Canada's ecumene, where regions used primarily for agriculture meet those of predominantly woodland and forest. For purposes of this study, the general boundary zone in which farm and woodland uses are intermixed is termed the agriculture-forest interface.

At the national scale, the dominant trend in land use change at the interface has involved a shifting of the boundary between farm and forest: generally speaking, agriculture has been advancing into forested lands in western Canada, whereas in eastern Canada forest cover has been invading former agricultural land (McCuaig and Manning, 1982). But, this broad and seemingly straightforward pattern discernable at the national scale, belies the complex character of land use patterns that can occur at regional and local levels. Over small areas of the agriculture-forest interface, land might be occupied by a wide range of economic activities including: agriculture, forestry, trapping, energy resource development and a variety of forms of recreation, although some land may appear to support little or no economic activity.

The intricacy of land use patterns at the agriculture-forest interface reflects the varied nature of relationships that exist between economic activities. In some cases, land uses are complementary, as, for example, when wildlife habitat conservation, watershed protection and certain forms of recreation are practised in the same area. In other cases, activities compete for the same land; the activity which prevails is commonly the one which is perceived as being the "highest and best" use, likely to produce the highest economic returns. Such a situation is exemplified by clearing forested lands for agricultural purposes.

Under the conditions of land use competition and change sketched briefly above, two general land-related issues emerge. A particular concern is the issue of effective allocation of the land resource, recognising both land capability and resource economics, and national, regional and local needs. It is difficult to undertake long range planning - and as long as 80 years are needed for forest crop rotation - if boundaries of the various allocated land areas are continually changing (Hellum, 1978). Not only have land use conflicts in areas of competition to be resolved effectively, but also the problems created by idle land or underutilisation should be addressed. A second general issue is that of land management. This is necessary both to prevent degradation of the land resource and to minimise the adverse impact of an economic activity both on other activities and on the environment in general.

Despite the vast area of land in the agriculture-forest interface and despite the importance of the issues raised by the extent of land use changes in this zone, the existence of the agriculture-forest interface as a nation-wide phenomenon has not been recognised. Study of land use change at the agricultureforest interface on a national scale has not been undertaken previously in Canada. Indeed, monitoring agriculture-forest land use change at any scale has been limited. Those studies which have focussed on such change, usually on a provincial, regional

or local basis, have generally viewed the question from the perspective of one sector, such as farmland abandonment (Beattie et al., 1981) or forest land alienations (Price, 1981). In recent years, some broader perspectives such as integrated resource management strategies (Alberta Energy and Natural Resources, 1981a) and cost-benefit analyses (Alberta Agriculture, 1983a) have been adopted usually in areas experiencing increased competition between resource users. But, these studies have generally focussed on a relatively small geographical area and ensuing protective measures have been largely reactive to a perceived problem commonly involving a land use conflict, rather than aimed at basing a solution on an understanding of the changes taking place.

The general aim of this exploratory study is to provide a basis for future research on land use change and issues at the agriculture-forest interface. This is achieved by means of an overview of sub-areas, land-related issues and available data sources that may be considered for further study.

## 1.1. Definition Of The Agriculture-Forest Interface

A variety of terms has been used in the literature to refer to the zone separating agricultural areas from forests: 'agricultural margin' (Beattie et al., 1981; Mandale, 1984); 'northern rural frontier' (Romanowski, 1983); 'pioneer fringe' (Romanowski, 1982). Most of these terms reflect the agricultural bias of the studies and they fail to recognize the element of land use change, a theme central to this study. The term "agriculture-forest interface" is defined as the general boundary zone separating the agricultural ecumene from forest where agriculture and forest land uses and covers are dominant and intermixed. In many geographical sub-areas along the interface, substantial land use change is occurring, as these two land uses tend to compete for the land base under appropriate economic conditions.

Due to various economic forces, the location of the agriculture-forest interface shifts over time. For purposes of this study, the general agriculture-forest boundary zone is delineated on the basis of significant rates of land use change over the 1961-1976 period as determined by McCuaig and Manning (1982) through analyses of census of Agriculture data at the level of the Standard Geographic District (usually a Census Division). Specifically, the agriculture-forest interface includes the Standard Geographic Districts which exhibited:

(1) an increase of over 25% in Farmland area and 20% in improved agricultural land, 1961-1976, or

(2) losses of 25% in Farmland and 15% in improved agricultural land (generally to an advance in forest or bush land) 1961-1976 - see Figure 1 (McCuaig and Manning, 1982, 57).

This is considered a sufficiently long period of time to permit identification of trends, although trends occurring in this period may have commenced prior to 1961 and may be linked to factors which had arisen even decades before. For instance, farmland abandonment was well underway in parts of eastern Canada by 1961, being related in part to economic

conditions and technological developments, some of which dated from the late nineteenth century and some of which took place in other parts of Canada and the world.

The various sub-areas of the agriculture-forest interface experiencing substantial land use change were identified for further analysis within this exploratory study on the basis of biolographic references and the informed judgement of researchers and planners in the land resource field (see Section 1.3), rather than quantitative indices. These areas were determined mainly within the context of the individual provinces and range in area from a few thousand to hundreds of thousands of hectares (Figure 1). Small areas in which land use change and land issues were site-specific and of purely local interest are not included.

As indicated at the outset, those sub-areas of the interface through the valleys of British Columbia, and across the northern part of the Prairies are generally characterised by an advancing agricultural and retreating forest land base, although a variety of other uses often compete for the lands too. On the other hand, through Ontario, Quebec and the Maritime Provinces intensity of active land use in interface areas has been declining, largely as a result of farmland abandonment.

## 1.2 Objectives Of The Study

With the intent of establishing a basis for future research on the agriculture-forest interface, this study has four primary objectives:

(1) to identify sub-areas of the agriculture-forest interface that are experiencing substantial land use change.

(2) to outline the land issues on the agriculture-forest interface that relate to the individual sub-areas and, if applicable, transcend these sub-areas to assume a wider provincial or national significance.

(3) to provide a summary of sources of appropriate information available to study the agriculture-forest interface. Such sources include bibliographic sources, data bases and air photo coverage.

(4) to discuss potential research approaches to further detailed study of land use change at the agriculture-forest interface.

## 1.3 Data Sources

Information for this study was obtained from three main sources: a literature search, mailed questionnaires and a review of air photo coverage indexes.

A review of the potentially relevant literature identified from computerised as well as traditional searches revealed a lack of work on the agriculture-forest interface. However, a much larger body of work, while not fully focussed on the interface, was of more than peripheral interest and forms the basis of the annotated bibliography (Appendix 5). A search of that literature permitted identification of some of the sub-areas of the agriculture-forest interface, some of the issues involved, potential data sources and selected government programs affecting land use in the sub-areas.

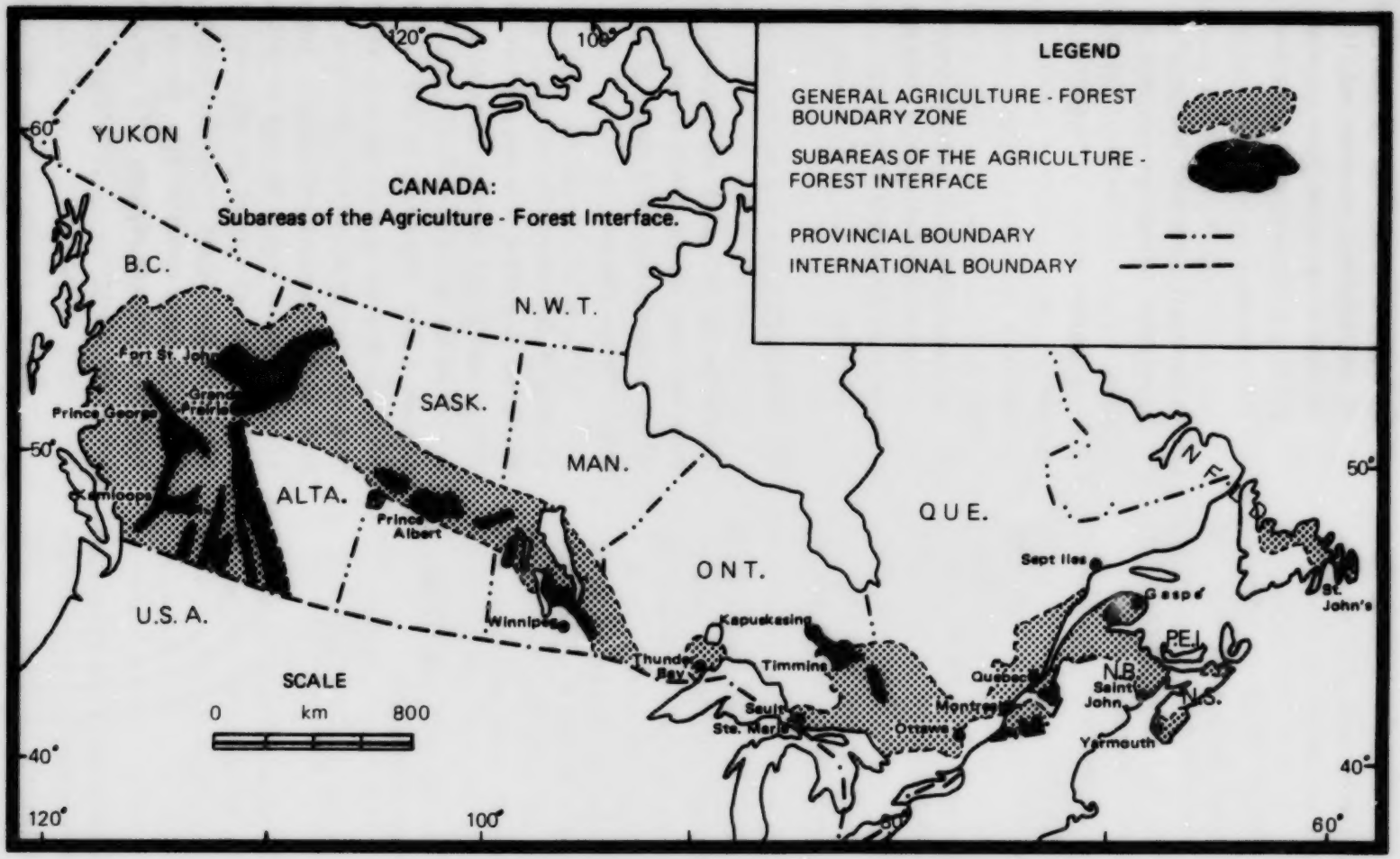
CANADA:
Subareas of the Agriculture - Forest Interface.
LEGEND
GENERAL AGRICULTURE - FOREST BOUNDARY ZONE
SUBAREAS OF THE AGRICULTURE - FOREST INTERFACE
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY
YUKON
B.C.
N.W.T.
SASK.
MAN.
ALTA.
ONT.
QUE.
N.F.
U.S.A.
P.E.I.
N.B.
N.S.
Fort St. John
Prince George
Kamloops
Prince Albert
Winnipeg
Kapuskasing
Thunder Bay
Timmins
Sault Ste. Marie
Ottawa
Montreal
Quebec
Saint John
Yarmouth
Sept Iles
Gaspé
St. John's
SCALE
0 km 800
120°
100°
60°
50°
40°

FIGURE 1.

In order to obtain more detailed perceptions of the geographical areas and land issues at the interface than were apparent from the literature, and to supplement information on data sources, government programs, and research and planning activities, a questionnaire was mailed countrywide (see Appendix 1). One hundred and fifty-eight questionnaires were sent to provincial and federal government personnel involved in forestry, agriculture, planning, environment and natural resource related activities; regional planning directors; academics; and private associations and consultants. The fifty-nine responses received included returns from personnel involved in a range of disciplines in most provinces. Responses were received from at least one, and more commonly several, provincial government contacts in all provinces except Ontario. This latter lack of response was overcome by a visit to Toronto, where seven interviews were conducted with provincial government staff. See Appendix 2 for a list of respondents.

In order to obtain information on the availability of air photo coverage in the area of interest, nine provincial governments, twelve private companies and the federal government were approached for a listing of all types of photography flown at scales at which reliable identification of land cover and land use can be made: between 1:20,000 and 1:60,000 (Stone, 1956). Details of coverage for the periods 1960-1962, 1970-1972 and 1980-1982 were requested so that aerial information was contemporaneous with available census information. In the event that coverage was not flown during these specific periods, it were requested that information regarding any photography available from 1960 to the present be forwarded. The area of interest was referred to by National Topographic System map sheet numbers (1:250,000).

## 1.4 Structure Of The Report

The report consists of three major parts:

(1) An overview by province of the geographic areas comprising the agriculture-forest interface with a discussion of locally, regionally and nationally significant land-related issues.

(2) An evaluation of information sources available for the study of land use change in the agriculture-forest interface. Sources considered include aerial photographs, maps, land use change and land resource data bases and research and planning studies. Gaps in information are identified.

(3) A discussion of approaches to the further study of land use change in the agriculture-forest interface, considering particularly the benefits and problems of a national overview compared with a case study approach.

## 2.0 ISSUES AND AREAS OF SUBSTANTIAL LAND USE CHANGE

Land resource issues associated with the agriculture-forest interface, as defined in the last section, are both complex and elusive. Some issues are present at a single scale of analysis whereas others may be present at a range of scales. For example, the question of whether or not to permit a low-level recreational use in an area of timber production is a local issue. On the other hand, a decision to extend agriculture on to a formerly forested area raises issues that can be examined in local, regional and national contexts. A second complicating factor in the identification of issues is that some relate to a single land use sector whereas others embrace a range of sectors. Furthermore, the spatial variation in the resource base results in a variation in issues from one locality to another, and from one province to another.

The following discussion of land resource issues and areas of substantial land use change in agriculture-forest interface is presented on a province-by-province, and sub-area-by-sub-area basis, partly because of the spatial variation in issues identified above. A second reason for a provincial approach is that administrative responsibility for public lands and land use legislation lies largely with provincial governments. Thus policies and initiatives relating to land issues vary from one province to another. Land use trends and issues in the province and sub-areas, however, should not be viewed in isolation, but rather should be viewed within the context of trends and issues at the national scale.

Nationwide, trends in land use change along the agriculture-forest interface are diametrically opposed: one of advance of agriculture into formerly forested areas in western Canada and another of abandonment of agricultural land and an advance in forest cover in central and eastern Canada. In the west, along the edge of the agricultural ecumene, a major concern is resource allocation in the face of claims from a variety of potential users, whereas in the east a lack of competition, leading to underutilised and idle land, is of particular concern. Reforestation projects in the east have covered a very limited area when compared with the total land that has passed out of agricultural use; most of the land is returning to forest by the process of natural vegetation succession.

The major issue at the national scale, resulting from the trends identified above, concerns the competition between the agriculture and forest uses for a land base of suitable capability. For a given small parcel of land, farming and forestry are mutually exclusive; and historically forests have been cut to make way for agriculture. Those lands taken for agriculture are generally higher capability forest lands; thus the forest land base is not only being reduced in area, but forests are being relegated to poorer and poorer land (Hellum, 1978). This process has continued to the point where grave concerns have been raised about the adequacy of the forest land base to maintain present production (Keating, 1983). At the same time agriculture, too, has generally been forced to occupy land of

lower and lower quality (Simpson-Lewis et al., 1979), as some of the prime (CLI classes 1 and 2) farmlands, in both eastern and western Canada, have been lost to urban expansion (Warren and Rump, 1981) as well as to land degradation processes such as salinization on irrigated land (Coote, 1983). New farmland at the agricultural frontier, however, is commonly of CLI class 3 or 4. It is ironic that, in areas of advancing agriculture, farming is being extended on to land that is relatively marginal for that activity, supplanting forests for which the land has a relatively higher capability. Thus the prime national concern of maintenance of the agricultural and forest land bases can only be appreciated from the perspective of land resource allocation in the country at large, rather than exclusively at the agriculture-forest interface.

The provincial analyses which follow identify the sub-areas of substantial land use change along the interface, the land use trends and issues in each sub-area and and a description of government involvement, if any, in land development, designation and regulation in the zone. Data for this section have been drawn from bibliographic references and, more particularly, interviews and questionnaires.

## 2.1 British Columbia

The primary national issue concerning land resources at the agriculture-forest interface - that of competition between agriculture and forest for an adequate land base - is also the main issue in British Columbia. On one hand there is concern for the long term security of forest land, understandable in view of the major contribution of forestry to the economy of British Columbia. According to a provincial forest resource analysis, the limits of a "standing merchantable crop of high quality, old growth timber ... are now in sight" (British Columbia, Ministry of Forests, 1980, 7). It was further predicted that once the old-growth stock has been removed, British Columbia's timber supply will decrease by about one-third unless forest management programs are stepped up (British Columbia, Ministry of Forests, 1980b). On the other hand, there is a desire to increase the province's independence in the agricultural sector by extending agricultural operations, often on to formerly forested public lands (Price, 1981). Most of the very limited amount of potential, higher capability farmland is in the valley bottoms, the same land that is regarded as being the most productive forest land. There are other activities competing for this land, too, including: urban centres, recreational subdivisions, industrial parks, rights-of-way and provincial parks.

The agriculture-forest interface sub-areas of British Columbia have a different spatial pattern and a different character from most sub-areas in the rest of the country. The distribution of land suited to particular land uses is highly influenced by topography. Many of the valleys, especially the valley floors, display some of the characteristics of the agriculture-forest interface (W. Swanson, G. Roberts, H.W. Sasaski, pers. comms.). Thus the major areas of land use conflict form a linear network through the province (Figure 2).

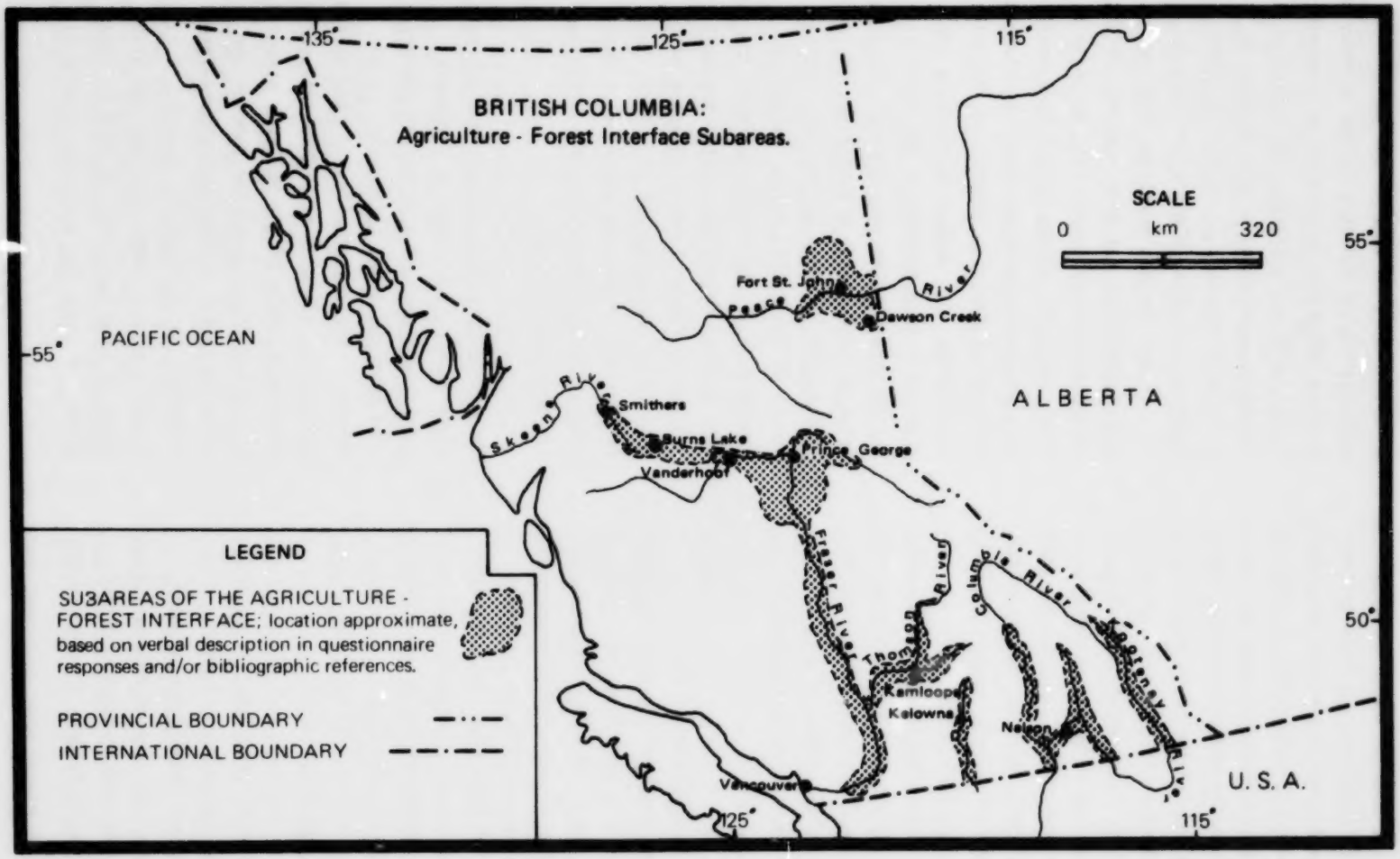
BRITISH COLUMBIA:
Agriculture - Forest Interface Subareas.
SCALE
0 km 320
135°
125°
115°
55°
50°
PACIFIC OCEAN
ALBERTA
U. S. A.
Fort St. John
Dawson Creek
Peace River
Smithers
Skeena River
Burns Lake
Vanderhoof
Prince George
Fraser River
Thompson River
Columbia River
Kamloops
Kelowna
Nelson
Kootenay River
Vancouver
LEGEND
SUBAREAS OF THE AGRICULTURE - FOREST INTERFACE; location approximate, based on verbal description in questionnaire responses and/or bibliographic references.
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY

FIGURE 2.

Settlement in agriculture-forest interface areas over much of the rest of the country is largely related directly to land or mineral resources, the absence of urban-related settlement on any scale being primarily a function of the considerable distance to major urban centres. The valleys of British Columbia, however, offer some of the few sites in the province suited to settlement. These sites attract not only resource-related settlement, but also exurbanites and activities, such as recreational facilities, designed to cater to a growing urban population in the valleys. The particular combination of conflicts present varies from one sub-area to another. One further distinction can be drawn between agriculture-forest interface areas of the eastern interior of British Columbia and many other interface areas in the country. At the advancing agricultural frontier, agriculture and forest are often mutually exclusive on a given parcel of land. Ranching on the Interior Plateau and Peace River regions of British Columbia, however, is commonly associated with forested areas, where open woodland and recently logged areas provide forage (British Columbia, Ministry of Forests, 1980b).

Substantial land use change on agriculture-forest interface was identified in six sub-areas on the basis of questionnaire returns and bibliographic sources (primarily British Columbia, Ministry of Forests, 1980b): Prince George Crown Land Plan Area, Kootenay-Nelson Region, Peace River Region, Vancouver Region, Cariboo Region, Thompson-Kamloops Region.

Two-thirds of the Prince George region is productive forest land. Substantial changes to land use have occurred locally. For example, in the Prince George Urban Centred Region there was a marked increase in the built up area and a loss of natural cover between 1965 and 1981 (Moore, 1984). In addition, 4,000 hectares in the Vanderhoof area were cleared annually for agriculture in the period 1975-1980. As timber is harvested, forage is available on the clear-cut sites. However, continuing, intensive grazing permanently removes the land from the productive land base for both timber and wildlife. In some areas livestock and wildlife compete for feed. Under the latter circumstances, changes in the land base are insidious. The impact of substantial recreational activity on agriculture and forestry in the area is not considered of significance. Agriculture has been extended less vigorously westward into the Smithers and Burns Lake area of Bulkley-Nechako, but there have still been significant losses of wildlife habitats and the forest land base to marginal agriculture (McClellan, pers. comm., 1983).

There is strong competition for resources in the Nelson-Kootenay region. Almost half of the total land is potentially productive forest land but timber harvesting is being forced into more remote areas. Between 1961 and 1971 the farm area in the Nelson region expanded from 10,000 to about 18,000 hectares. Since 1961 there has also been expansion of recreation, open-pit coal mining and hydro-electric power generation. All have consumed formerly forested land, but the large storage reservoirs created by the Mica, Duncan, Hugh Keenleyside and Libby Dams have removed productive land from both the agriculture and forest land bases. The

extensive network of transmission lines consumes additional forest land.

The Peace River region differs from other regions in British Columbia in that agricultural land is more extensive and is not restricted to narrow valley corridors. The main trend in land use in the region is the conversion of forest land to agriculture (R. Taylor, pers. comm., 1983), causing losses of wildlife habitat and forest capacity. Land clearing for agriculture has been proceeding at an increasing rate, reaching an average of 15,000 hectares per year in the period 1971-1976. The principal area of agricultural expansion since the Second World War has been north of the Peace River valley, focussing on Fort St. John (Vanderhill, 1982). Exploration, extraction and movement of oil and gas, the major source of revenue of the region, has resulted in the loss of substantial areas of forest land. In 1978 alone, the loss of productive forest land has been estimated at 3,300 hectares (British Columbia, Ministry of Forests, 1980b, 304). Once such initial losses have been made, conflicts between petroleum extraction and forestry are not considered great. Similarly, hydro-electric power projects generally consume substantial tracts of land; for example, a proposed dam on the Peace River near Fort St. John, would flood 3,600 hectares of productive forest land. Unlike oil and gas installations such loss of land is localised and often involves higher capability forest areas. The valley floors are also the prime habitats for moose, elk and white-tailed deer; if wildlife management programs are to be effective, long term reservations are needed on timber stands, reducing the availability of certain species of trees such as white spruce (British Columbia, Ministry of Forests, 1980b, 323).

In the Vancouver region, increasing urban-based populations are exerting the main pressure on land. Urban growth is being directed into forested areas north of the Fraser River, because agricultural land reserves, established in 1972, protect agricultural lands of the Fraser valley from urban encroachment. The rising population makes increasing demands for recreation and it is speculated that, in the future, parks will compete with timber for many of the same sites.

Competition for land resources is not as great in the Cariboo region as in adjacent areas, especially those to the south. Forestry is the main activity and the rate of timber harvest has caused some concern about the conservation of wildlife habitats. Of particular concern is the widely dispersed pattern of logging roads that makes wildlife protection difficult. In addition some problems in integrating timber and range management have been encountered (British Columbia, Ministry of Forests, 1980b, 687).

A wide variety of demands is placed on land resources in the Kamloops region, the particular demand varying from one part of the region to another. A major concern in one of the most important agricultural regions of the province, the Okanagan Valley, is the relationship between forestry, watershed protection, water supply and agriculture. Irrigation is required for many crops and timber harvesting on watersheds can influence total water yield, run-off regime and flood

control. Forest harvesting and wildlife conflicts are of considerable concern locally such as in the North Thompson Valley (British Columbia, Ministry of Forestry, 1980b, 548).

Several provincial ministries exert influence on land use change in British Columbia: Forests, Environment, Municipal Affairs and Lands, Parks and Housing; as well as local government. The aims of such bodies are not always easily reconcilable.

The Ministry of Forests took steps in 1979 to maintain the potential for a timber harvest of at least 75 million cubic metres by establishing fifty new provincial forests. Within the forest industry the program is viewed as the key to inhibit further alienation of the forest land base (Dawkins, 1981). Under the scheme, broad zoning is introduced to distinguish in general terms between Crown land available for multiple use forest and range management and land available for agriculture, settlement and other non-forest use.

Unalienated Crown lands in British Columbia are allocated and managed by the Ministry of Lands, Parks and Housing, established in 1978 under the Land Act. A major element of the resultant Crown Lands program is to provide opportunities to use Crown land for non-forestry uses: agricultural, recreational, residential and industrial. A series of Crown Land Plans have, and are continuing to be, drawn up (see for example, British Columbia Ministry of Lands, Parks and Housing, 1981). Many such plans are likely to result in conversion of forest land to agriculture. In 1980, the agricultural part of the plan was modified permitting any resident of the province to settle on agricultural Crown land. Prior to the modification only bona fide farmers wishing to expand their operations were allowed such land. Such a program is in potential conflict with the Ministry of Forests' Provincial forest scheme.

An attempt to resolve land allocation problems involving forestry, agriculture and recreation has been made by a joint venture of the Ministries of Forests and Lands, Parks and Housing. Thirty-four "Deferred Planning Areas" throughout interior British Columbia were designated for study, in order to determine the most appropriate land use.

While the Crown land and Provincial Forest programs are an expression of policy of their respective Ministries, the schemes do effect land use change at the local level. However, many local detailed planning matters are largely the result of district planning achieved by the development of official settlement plans.

In summary, prime sites for agriculture, forestry and urban development in British Columbia, the valley bottoms, are in short supply, a product of the physical attributes of the province. Resource allocation is clearly a key issue over extensive lengths of the agriculture-forest interface corridors. Locally, management issues, such as watershed protection, dominate because of their implications for specialised agricultural areas.

## 2.2 Alberta

A key issue in Alberta as a whole is the long term security of the agricultural land base (Alberta Energy and Natural Resources, 1983a), a concern which has obvious implications for the national issue of competition between the forest and agricultural land bases. Three broad zones were designated in 1948 by Order-in-Council: the Green Area is the forested zone of Alberta from which agricultural pursuits, other than grazing, are excluded; the White Area is the central and southeastern part of the province that attracted the first commercial agriculture, and the Yellow Area is the settled part of the Peace River Region. Most provincial government policy has favoured the clearing of forested land for agriculture. Total farm area has expanded particularly along the northern margins; in the Northern Development Council area, total farmland increased by over one-third between 1961 and 1976 (Alberta Agriculture, 1983a). Such expansion has partly been at the expense of the Green Area. While the advance of agriculture into former Green Areas causes a direct reduction of the forest land base, shifts in the boundary between settled and forested areas also hinder long range forest management planning and long term financial investment (Environment Council of Alberta, 1979, 66). Thus the stabilisation of the Green Area boundary is regarded as an important issue in forest management planning (Alberta Energy and Natural Resources, 1983a).

The competition for land in the agriculture-forest interface areas of Alberta should not be viewed in isolation, however, from land use trends in the rest of the province. Briefly, while agricultural production has been expanded through additions to the agricultural land base, outlined above, as well as through increases in productivity, there have also been losses in the size and quality of the agricultural land base through both the encroachment of non-agricultural uses such as urban and related developments, and a reduction in soil quality by soil erosion, salinisation and acidification (Thompson, 1982). As in the country at large, losses of farmland to urban expansion tend to involve higher capability farmland, whereas additions to the agricultural land base at the margins are usually of a lower agricultural capability. Between 1976 and 1981, Alberta suffered a net loss of about 35,300 hectares of agricultural land in CLI classes 1 to 3 and a net gain of over 150,000 hectares in CLI classes 4 to 6 and organic soils (Alberta Agriculture, 1983b).

While the main land issue in Alberta concerns the competition between agriculture and forestry, there is a large number of other potential land use conflicts. Energy resource extraction occurs widely through the agricultural zone and along the boundary of the Green Area. Although the Green Area is managed for multiple use, including timber, water production, fish, wildlife, industrial development, and energy resource extraction, the latter can cause considerable disruption to timber production. Seismic lines alone are estimated to occupy over 234,700 hectares of Green Area, almost equalling the total timber harvest of 255,692 hectares between 1956 and 1976 (Thompson, 1982, 6). In

addition to the direct loss of timber, seismic lines hinder timber management.

Recreation is a further economic activity with the potential for competing for both agricultural and forested land. Over 1,200 hectares of productive forest land in the province are being removed annually for recreational and related uses (Alberta Agriculture, 1983a, 13), and recreational activity is expected to have tripled by the year 2000, creating a demand for increased access and development of facilities (Environment Council of Alberta, 1979, 10). Other land resource concerns include watershed and wildlife protection which are threatened in particular by land clearing operations for agriculture and to a lesser extent by energy resource development. The particular combinations of issues relating to local areas vary from one part of the province to another.

The principal sub-area of agriculture-forest interface in Alberta, the Peace River Region, was identified as such by all questionnaire respondents from Alberta (Figure 3). There is also a rapidly growing literature detailing land use changes, assessing the potential of the area for agriculture and analysing resultant land issues. (See, for example, Alberta Energy and Natural Resources 1983a; 1983c; 1978a; Beattie et al. 1981; McCuaig and Manning, 1982; Nichols and Associates, 1981; Pettapiece and Lindsay, 1981.) The Eastern Slopes of the Rocky Mountains have also been suggested as a secondary sub-area of Alberta's agriculture-forest interface (J. Rivait, pers. comm., 1983).

The Peace River Region, encompassing about 25 million hectares in northwestern Alberta, has climate, soils and vegetation typical of boreal environments at similar latitudes. The higher capability agricultural lands at lower elevations in the Wapiti Plain, the Peace River Lowland and the Fort Vermillion Lowland (Pettapiece and Lindsay, 1981) were settled first, leaving the moderate to marginal lands for subsequent settlement. In recent years the Peace River Region has been subjected to a variety of land resource conflicts, including demands for agricultural expansion, petroleum and natural gas development, and demands to protect wildlife populations and habitats (Alberta Energy and Natural Resources, 1983a). Coupled with the provincial government policy to expand the agricultural land base, there has been a high demand from the region's farmers for more farmland. In 1982, there were 1,023 new farms established in the Peace River Region and for each new parcel available for agriculture there were two or three applicants (Alberta Agriculture, 1983a, 108). Approximately 110,000 hectares of public land were opened in the Peace River area for agricultural use between 1976 and 1981. It is estimated that this figure represents about 75 percent of new land opened during the same time period in the entire province (Alberta Energy and Natural Resources, 1983c).

With less accessible and lower capability land being opened to agriculture, controversy has arisen regarding the viability of farming in such areas. There is conflicting evidence regarding crop yields that can be obtained in the Peace River Region compared with southern areas

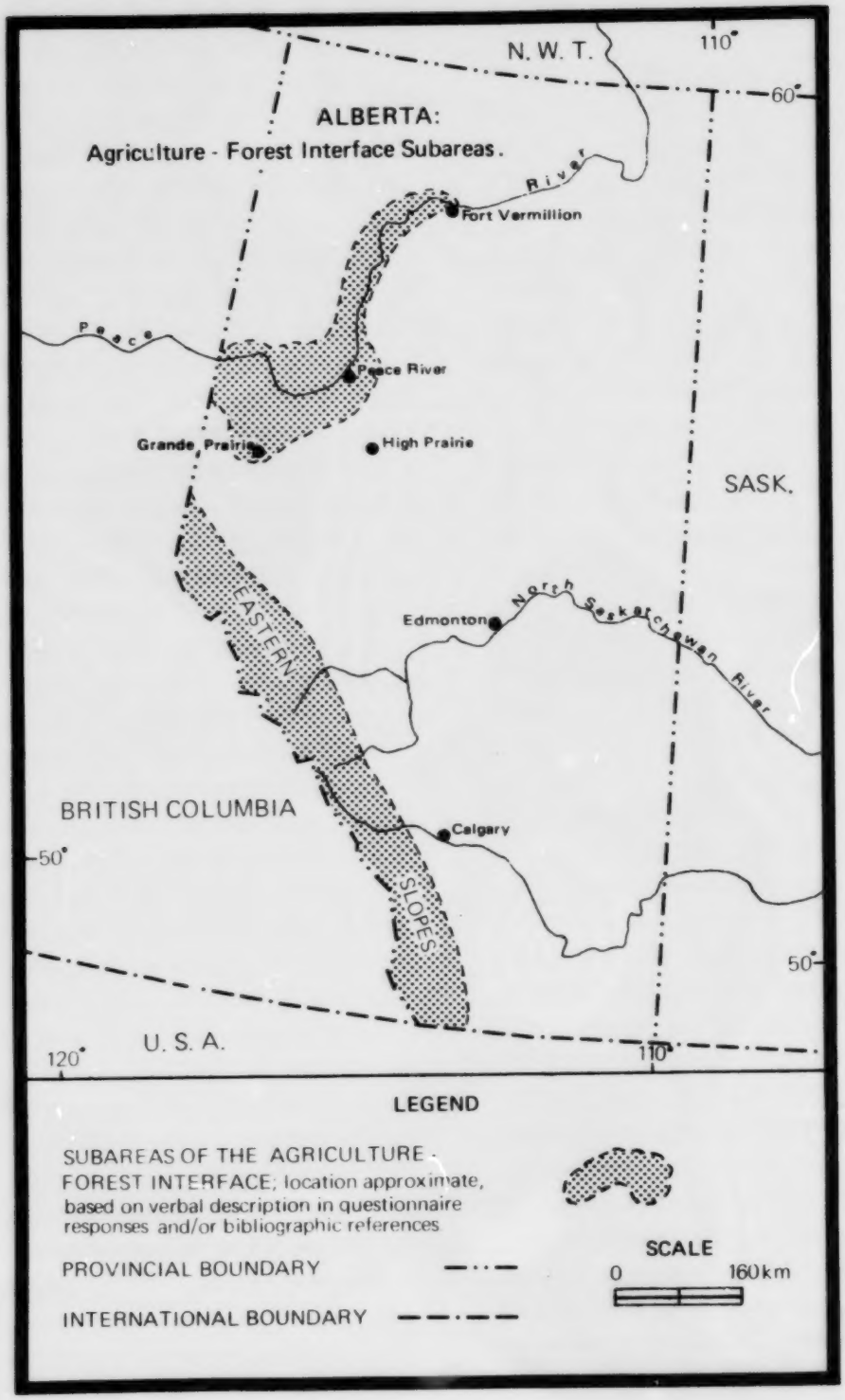
N. W. T.
110°
60°
ALBERTA:
Agriculture - Forest Interface Subareas.
Peace River
Fort Vermillion
Peace
Peace River
Grande Prairie
High Prairie
SASK.
EASTERN
SLOPES
Edmonton
North Saskatchewan River
BRITISH COLUMBIA
Calgary
50°
50°
U. S. A.
120°
110°
LEGEND
SUBAREAS OF THE AGRICULTURE - FOREST INTERFACE; location approximate, based on verbal description in questionnaire responses and/or bibliographic references
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY
SCALE
0
160 km

FIGURE 3.

of the province. Although much of the region has just over 2,000 degree days, which is considered the lower limit for a variety of grain crops, the heat is concentrated into a short growing season of between 60 and 100 days (Simpson-Lewis et al., 1979), requiring the development of rapidly maturing crop varieties. Several other barriers to agricultural development have been recognised (Kelly, 1982; Alberta Agriculture 1983a and 1981; Alberta Energy and Natural Resources, 1983b and 1983c). These range from physical factors, such as the susceptibility of cleared hill slopes to sheet and rill erosion, to economic factors such as the high cost of clearing land and the reliance that farmers must place on off-farm income. The social and economic infrastructure on the advancing agricultural frontier is poorly developed, requiring either the infusion of large amounts of capital or acceptance of inferior social conditions and commercial facilities such as grain handling and transportation systems. It is generally recognised, however, that, whatever the viability of newly opened areas to support agriculture, the crop environment of the Peace River is very different from the environment in southern Alberta. Different crops, crop varieties and management practices are therefore required.

The Eastern Slopes of the Rocky Mountains have not undergone the same widespread forest clearance for agriculture as the Peace River Region, but there has been a sharp increase in recent years in the demand for the utilisation of various resources (Alberta Energy and Natural Resources, 1981b, 20), including requests for grazing and agricultural permits, and rural residential and recreational uses. If forest clearance continues, watershed protection and water management for the Prairie provinces will become issues. According to J. Rivait (pers. comm., 1983) this area requires "the most intensive management of all areas within the province".

The provincial government of Alberta has played a significant role in influencing recent changes in land use at the agriculture-forest interface of the province. While the designation of the Green, Yellow and White areas in 1948 was an attempt to provide the basis for long term planning there has been active encouragement of agricultural expansion since then, especially on to formerly forested public lands. Three methods of disposing of public lands for agriculture have been employed, the method used in a particular case depending on the size of the area involved and the potential uses for the area (Alberta Energy and Natural Resources, 1983c). For disposal of small parcels, individual farmers can apply to the Public Lands Division, whereas the Public Lands Division posts larger tracts to meet growth objectives set by the provincial government. The conversion of particularly large tracts of land and areas in which resource management conflicts occur require the preparation of an integrated resource plan before the boundary between the Green Area and the Yellow or White Areas can be changed. At present there are integrated resource plans being prepared for three areas in the Peace River Region: Jean D'Or Prairie, Sturgeon Lake Puskwaskan East and Frost Hills. A major component of each of these plans is

an evaluation of the Green/Yellow Area boundary with a goal of expanding the agricultural land base and the resolution of related conflicts.

Despite the clearing of extensive tracts of forested public land for agriculture in the Peace River Region in the recent past, the provincial government has recently instituted an Accelerated Land Sale policy in an attempt to satisfy a perceived unsatisfied public demand for new farmland in the Peace River Region (Alberta Energy and Natural Resources, 1983c). This policy aims at doubling the new agricultural land designations to 100,000 hectares annually over the next five years. Obviously, considerable outlay of capital for land clearing, roads and other components of the economic and social infrastructure will be required if the goal is to be met.

Faced with a continuing high demand for conversions from forest to agricultural land, the Alberta Department of Energy and Natural Resources established the Peace River Regional Resource Management Committee to "achieve a high level of coordination in resource management programs, planning and operations with the renewable resource sector of the department" (Alberta Energy and Natural Resources, 1983c, 16). In a systematic attempt to identify resource management issues, the Peace River Regional Resource Management Committee, in conjunction with the Resource Planning Branch of Alberta Energy and Natural Resources, conducted a study of resources, their management, and present and potential conflicts. The resultant report (Alberta Energy and Natural Resources, 1983a) lists, in order of priority, almost sixty resource management concerns, grouped according to sector.

The agricultural land base/forested land base group of issues was identified as the dominant concern of the region. The list of component issues includes large scale expansion of the agricultural land base and production, timber management and development, stabilisation of the Green Area/Yellow Area boundary, pressure on wildlife species, and soil erosion. Resolution of the issues depends on an ability to determine requirements for both the agricultural and forested land bases satisfactorily as well as to bridge gaps in the decision-making machinery at provincial, regional, sub-regional and local levels. A major potential stumbling block is the difficulty of undertaking resource management when executive groups have overlapping responsibilities. In Alberta eight agencies in three government departments administer 38 provincial acts relating to land use in the Green Areas (Environment Council of Alberta, 1979, 86). The mandate of the regional resource management committees includes an attempt to resolve interdepartmental conflicts and a review of inter-agency operating procedures related to agricultural expansion.

The Eastern Slopes of the Rocky Mountains is scheduled to have a more comprehensive spatial coverage of integrated resource planning projects than the Peace River Region. In 1977 the Alberta Government announced a policy statement for multiple use and integrated land management in the

region (Alberta Energy and Natural Resources, 1981b, 21), following increased competition for land and piecemeal planning in the early 1970's (Alberta Department of Municipal Affairs, 1974).

The major concern in Alberta - the long term security of the agricultural land base - has stimulated large scale expansion of agriculture especially in the Peace River Region, despite questions about the viability of farming in such marginal areas. Land pressures have been increasing on the Eastern Slopes of the Rocky Mountains as a variety of uses compete for formerly forested land. The retreat of the forest boundary in both agriculture-forest interface sub-areas hinders long range forest management planning.

## 2.3 Saskatchewan

Saskatchewan has the least active agricultural frontier of the four western provinces (Vanderhill, 1982). With minor exceptions, the agricultural margin in the province has been largely stationary for the last 50 years. By the 1930s the northern limit of agricultural settlement had reached the southern edge of the agriculturally unproductive boreal forest zone. Thus only small amounts of land suited to agriculture were still unalienated and release of such land has been controlled more rigorously than in Alberta (Ironside et al., 1974, 22). Since the 1930s agricultural development has been restricted mainly to areas that had been already generally committed to that use. Such development commonly involved the expansion of existing farms through the lease of Crown bushland, rather than the creation of new farms.

Areas of recent high rates of agricultural expansion include segments of the Carrot River lowland to the east of Prince Albert (Vanderhill, 1982) and the Meadow Lake (Shannon, 1974) and Lloydminster areas (Saskatchewan Urban Affairs, 1982) in the west of the province (Figure 4). Parts of the Carrot River lowland represented the only sizeable area of Crown land with agricultural potential remaining in the province. In the immediate postwar years veteran settlement projects were sited on two blocks of land and in the mid-1960s drainage of lowland areas was undertaken in an attempt to satisfy local demand for farmland. However, demand for land was sustained into the early 1970s but an additional, potentially productive, area of the lowland was not made available because it had been designated as a major wildlife reserve.

Agriculture has been expanding steadily in the Meadow Lake area since 1941 (Shannon, 1974). The area in improved farmland almost doubled between 1951 and 1971. Although the region is regarded as part of the commercial forest zone, a major conflict between forestry interests and agricultural interests has not been reported, but some concern has been expressed (L. Walker, pers. comm., 1983). Timber producing capability of the area is not high; trees are slow-growing and relatively small, a result of a short growing season and low precipitation. Pressure on land has not been high partly because of the poorly developed economic and social infrastructure.

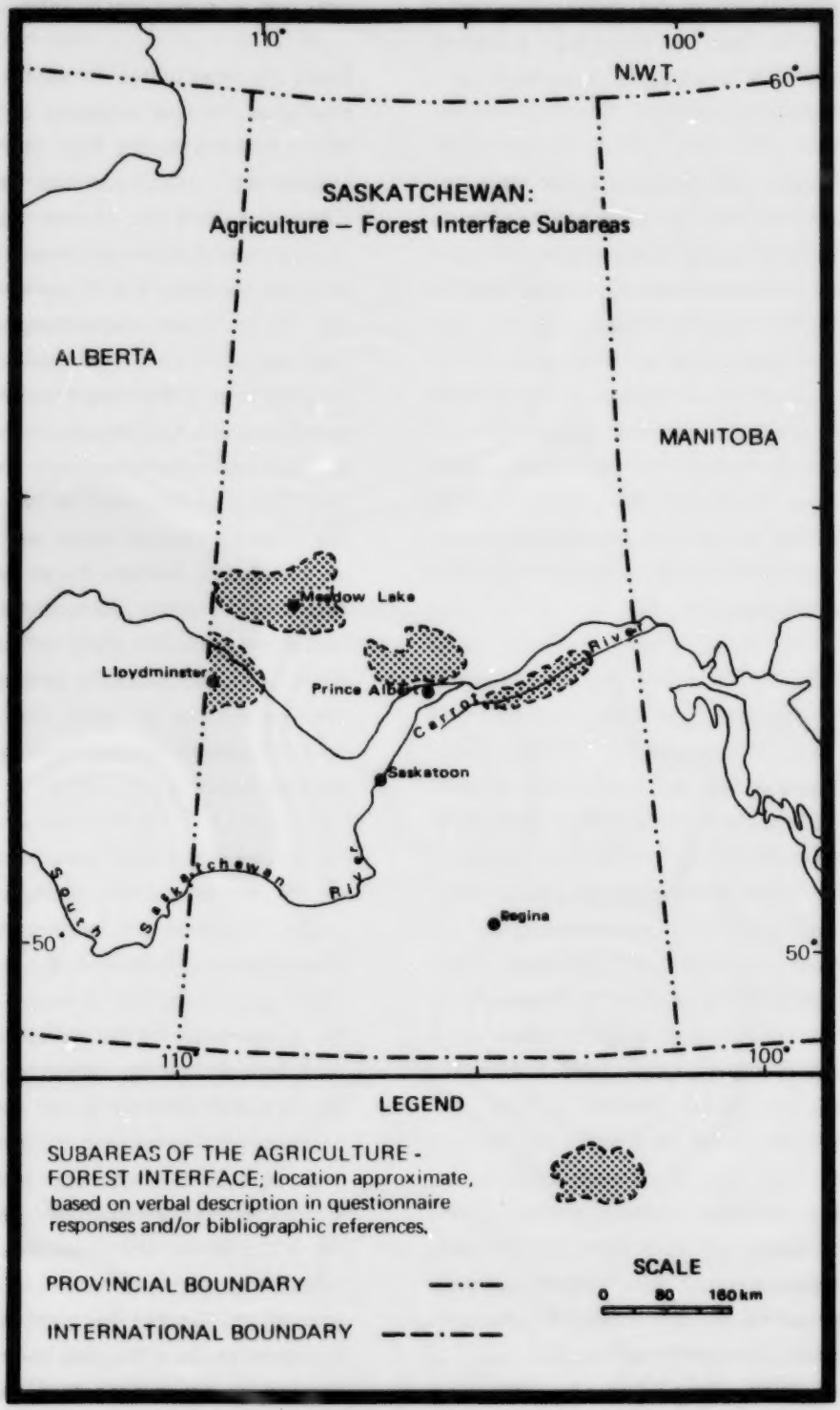
110°
100°
N.W.T.
60°
SASKATCHEWAN:
Agriculture – Forest Interface Subareas
ALBERTA
MANITOBA
Meadow Lake
Lloydminster
Prince Albert
Carrot River
Saskatoon
South Saskatchewan River
Regina
50°
50°
110°
100°
LEGEND
SUBAREAS OF THE AGRICULTURE - FOREST INTERFACE; location approximate, based on verbal description in questionnaire responses and/or bibliographic references.
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY
SCALE
0 80 160 km

**FIGURE 4.**

Land-cover changes in the Lloydminster area south of the North Saskatchewan River and bounded by 110°00 longitude and 53°00 latitude were analysed for the period 1966 to 1980-81 (Saskatchewan Urban Affairs, 1982). In an area of approximately 336,000 hectares, cropland increased from 58.8 percent coverage of the study region to 83.9 percent coverage, an increase of nearly 90,000 hectares. These increases were made at the expense of grasslands and rough pasture, which contracted by over 50,000 hectares, and bush and tree cover, which shrank by about 33,000 hectares, representing well over a half of the region's bush and tree area. While involving much smaller areas of land, oil exploration and production has been competing for the land base in this area, too.

Although substantial expansion of agriculture at the expense of forest land and wetland has been restricted to relatively small areas, there have been less marked land use changes along much of the agriculture-forest boundary in Saskatchewan. This general zone extends from Meadow Lake in the west to the north of Prince Albert in the centre of the province and continues towards the settlement of Hudson Bay in the east. Across much of the zone there has been an increase in non-farm residents and north of Prince Albert cottaging and recreational developments have been sited on formerly forested land (L. Walker, pers. comm., 1983).

The development of community pastures has taken place widely throughout Saskatchewan's agricultural zone but in the last twenty years new Provincial and Association Community Pastures have been established primarily in the aspen-grove parkland and mixed forest of the agriculture-forest interface (Saskatchewan Environment, 1980). Provincial Community Pastures are operated on provincial lands controlled by the Saskatchewan Department of Agriculture. Most of the 34 community pastures established between 1962 and 1976 are in the aspen-grove parkland and mixed forest regions and are commonly between 1,000 and 5,000 hectares. Association Community Pastures, in general smaller than Provincial Community Pastures, have been established by co-operative grazing associations on private and/or leased provincial land. The highest concentration of Association Community Pastures, for the most part established in the 1950's and 1960's, is located in the mixed forest zone north of Prince Albert.

Although there are conflicting views regarding the adequacy of the supply of land for different land uses in Saskatchewan's agriculture-forest interface (Saskatchewan Environment, 1980, i), it is probable that conflicts are not as acute as in similar areas of British Columbia and Alberta. Nevertheless three general issues have been identified as requiring attention (Saskatchewan Parks and Renewable Resources, 1983).

(1) Competition for surface resources. If current trends continue conflict and competition between land resources (agriculture, forestry, wildlife, recreation, mineral extraction) will intensify and reduce future options for resource use.

(2) Competition between surface and subsurface resources. Improved accessibility is leading to an increased demand for mineral resources

and surface uses. A potential cause of competition and conflict is the separate tenure of surface and subsurface resource rights.

(3) Conflict between transportation and surface environments. Roads particularly are considered to have reduced the opportunity for a wilderness experience.

In addition there is concern about the adequacy of the social and economic infrastructure to attract and support a viable agricultural industry in the agriculture-forest interface (L. Walker, pers. comm., 1983).

No comprehensive land use policy currently exists in Saskatchewan; planning takes place in the context of a specific resource interest. A wide array of both provincial and federal legislation regulates and assists agriculture and forestry. For example, the Forest Act provides for management of provincial forests and for the protection and exploitation of forest products on other provincial lands. Nine provincial forests were established in 1931 under the Forest Act covering over 30 million hectares including all land north of latitude 55 degrees.

The 338,700 square kilometres of Crown land in Saskatchewan constitute approximately 43 percent of the provincial land base; the land is administered mainly by Saskatchewan Parks and Renewable Resources, which recognises a "critical need for more intensive management of Crown land and associated resources in response to rapid change and integrated management objectives of the province" (Saskatchewan Parks and Renewable Resources, 1983, 1). An integrated approach to planning and management of Crown land similar to the one used by Alberta Energy and Natural Resources for the Eastern Slopes and to Strategic Land Use plans of the Ontario Ministry of Natural Resources, has been proposed to operate within existing legislation (Saskatchewan Parks and Renewable Resources, 1983). The scheme is intended to implement government policies and guidelines for allocation and development of Crown lands, in order to ensure long term security and productivity of public land, while at the same time accommodating increasing resource needs of a wide array of users including residents, businesses and visitors to the province.

The Resource Lands Planning and Management Program has four basic components.

(1) Policy development. Existing policy, usually developed within the context of a single sector, will be reassessed in the light of its potential place in an integrated planning scheme. To date, a series of required policy developments has been identified including: agricultural leasing and land policy and land freeze policy for both naturally and culturally sensitive areas. A policy is also required to implement a resource lands zoning system embracing a wide range of uses: trapping, fishing, hunting, logging, mineral exploitation, agriculture, recreation, transportation and utility corridors and so on.

(2) A computerised data base with cost-effective retrieval of data. This is required to permit monitoring of land uses. Existing information systems will be expanded and integrated to meet this goal.

(3) Resource Lands Planning Process. This will range from definition of the planning area, through the selection of an approach to planning, to scheduling of an implementation program.

(4) Special Area Planning. Such projects will be undertaken outside the context of the planning hierarchy to tackle special problems such as rapid and radical changes in land use as a result of improved accessibility.

Pressure on land in the agriculture-forest interface of Saskatchewan is not as great an issue as in British Columbia and Alberta. Nevertheless substantial clearing of bushland for agriculture has taken place in the Lloydminster and Meadow Lake areas in the west and the Carrot River lowland in the east, and cottage and recreational development have characterised the central part of the province north of Prince Albert. The need for more intensive management of land has been recognised and a strategy for resource lands planning and management of Crown land has been proposed.

## 2.4 Manitoba

The agriculture-forest boundary zone in Manitoba extends diagonally southeastwards across the province from Porcupine Mountain in the west to the edge of the Canadian Shield northwest of Lake of the Woods in the east (Romanowski, 1982; Vanderhill, 1982). In general the type of land use change most frequently identified by questionnaire respondents has been conversion of wetland and forest land - under a variety of uses including forestry, hunting and trapping - to agricultural and, more locally, recreational use. Two areas were cited most frequently as being particularly subject to land use change: the Interlake region and the Winnipeg River section to the east of Lake Winnipeg (Figure 5). Several smaller, discontinuous areas in western Manitoba were identified as having experienced expansion of agriculture over the last 25 years.

The primary concern among questionnaire respondents in Manitoba is the conflict between wildlife, forestry and agricultural interests. The more fundamental issue involved is the extent and timing of conversion from extensive natural resource extraction, including forestry, hunting and trapping to more intensive agriculture with its associated infrastructure (W.P. Barto, pers. comm., 1983). The resultant agricultural activity is often marginal in nature (R. Jackson, pers. comm., 1983). Such land use conversions imply a change from multiple to single use by limited and selective users, a point causing increasing concern (D.T. Schindler, R.H. Lamont, B.E. Seppala, pers. comms., 1983).

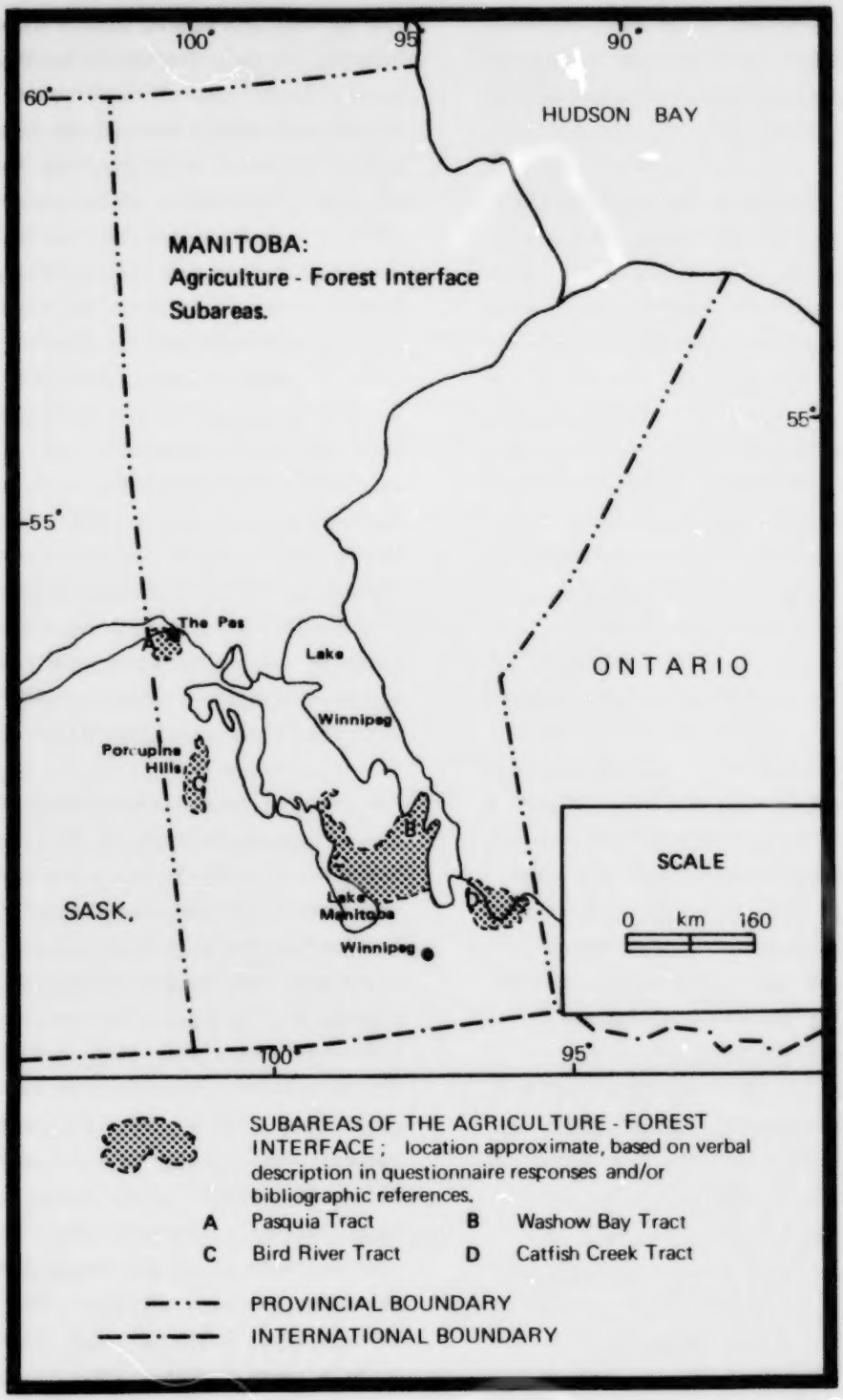
100°
95°
90°
60°
HUDSON BAY
MANITOBA:
Agriculture - Forest Interface
Subareas.
55°
55°
The Pas
Lake
Winnipeg
ONTARIO
Porcupine
Hills
SCALE
0 km 160
SASK.
Lake
Manitoba
Winnipeg
100°
95°
SUBAREAS OF THE AGRICULTURE - FOREST INTERFACE ; location approximate, based on verbal description in questionnaire responses and/or bibliographic references.
A Pasquia Tract
B Washow Bay Tract
C Bird River Tract
D Catfish Creek Tract
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY

**FIGURE 5.**

As in other parts of the Prairies and British Columbia, the nature of land use change and resultant issues varies slightly from one sub-area in the agriculture-forest interface to another. The primary trend in the Winnipeg River section to the east of Lake Winnipeg is conversion of land from hunting, trapping and commercial forestry to intensive recreation and agriculture. Some changes in use that are occurring, however, are not as easy to detect as those cited above. The conversion of land from multiple use, focussing on forest and wildlife, to wilderness recreation is not visually obvious, but has a substantial impact on available resources.

A similar general trend to the one in Winnipeg River section exists in the Interlake region: Crown land is being brought into private ownership for agricultural purposes. In addition to site-specific recreational expansion, especially cottaging in shoreline areas, hydro-electric installations have increased in the sub-area (J. Friesen, pers. comm., 1983).

Agricultural development in the western areas of Manitoba has been more highly localised than in the east. Both the Birch River Tract at the eastern foot of Porcupine Mountain and the Pasqua-Carrot River area to the south of The Pas were former wetlands, opened to agriculture by drainage schemes (Vanderhill, 1982). In the latter case, the area was originally used for trapping and hunting; agricultural activity has tended to focus on grazing, hay production and cropping (J. Friesen, pers. comm., 1983). Part of the demand for farmland in the Pasqua tract is for hobby farms. Locally the most controversial land issue is the competition for agriculture for the Saskeran Wildlife Management area (Vanderhill, 1982).

Land use in the agriculture-forest interface areas of Manitoba is influenced by a series of government programs including those providing increased access, land drainage, and wildlife habitat conservation and development. Two programs have particularly strong influences on land use change on Crown lands. Under the Manitoba Crown Land Improvement Program, administered by the Department of Agriculture, a land development fund is available for improvement to agricultural Crown land. The funds are recovered at the time of sale or over the period of the lease. This program encourages the expansion of agriculture on Crown lands and heightens competition between resource sectors (D. Schindler, pers. comm., 1983).

A second major influence on land use on Crown lands has been the Crown Land Classification Committee which, since 1965, has prepared plans systematically for southern Manitoba and much of the agriculture-forest boundary zone. The Committee has recently undertaken two land use planning projects in the agriculture-forest interface: the Washow-Fisher Land Use Study and the Catfish Creek Land Use Study. The principal objective for each plan is to rationalise and allocate the Crown land and natural resources in the area (W.P. Barto, pers. comm., 1983). Additional plans for the Winnipeg River and Lac du Bonnet Planning

Districts and the north Interlake area are expected to be developed in the near future.

As in most of western Canada, the major concern in agriculture-forest interface sub-areas of Manitoba is the conversion of multiple use forest land to single use agricultural land, often of a marginal agricultural nature. Government programs have in many cases encouraged such conversions. Additional pressure is being applied by recreational demands at specific sites in eastern areas close to Winnipeg, a trend typical of most major Canadian cities.

## 2.5 Ontario

In contrast to the underlying trend of farm expansion at the expense of multiple use forest in agriculture-forest sub-areas of the Prairies and British Columbia, the study areas of Ontario and provinces to the east have been characterised by a reversion of former farmland to bush and forest. In western Canada, resource allocation in the face of competition and conflict between resource users, notably forestry and agriculture, is the major issue; in Ontario the main concerns focus on the social and economic impact of widespread withdrawal from agriculture and the allocation of land for the anticipated future, rather than immediate, use.

The major agriculture-forest interface sub-areas in Ontario are, as shown in Figure 6, the Great Clay Belt situated north of the Great Lakes-James Bay drainage divide and centred on Cochrane, and the Little Clay Belt located immediately north of Lake Temiskaming (Troughton, 1983; R. Monzon, pers. comms., 1983). Minor sub-areas occur near Dryden in northwestern Ontario (R. Monzon, pers. comm., 1983), Sudbury (T. Wu, pers. comm.) and on the southern fringes of the Canadian Shield in central Ontario (Parson, 1979).

Both Clay Belt areas are characterised by extensive deposits of glacial clays, commonly poorly drained and of variable fertility and depth (Troughton, 1983). Their physical potential to support agriculture has long been recognised but that potential remains largely untapped. The main settlement wave was linked to railway construction and government initiatives in the 1911 to 1931 period, the maximum extent of agriculture being reached in about 1941. From then until 1971, widespread farmland abandonment occurred with declines highest from 1955 to 1965. Rates of decline slowed in the 1970s and the improved farmland category actually registered increases in the 1971 to 1976 period. Nevertheless farms today occupy less than four-fifths of the farmland once occupied and most farms are part-time, low income operations, distributed in a series of widely scattered locations (Troughton, 1983).

The fundamental question with respect to the Clay Belts is whether or not any permanent agricultural settlement can be maintained outside the processing and service centres (Troughton, 1983). Although potential productivity is well below that of southern Ontario, climate is not a major limiting factor; the agroclimatic index for the Clay Belt is similar to that over much of the Prairies. However, terrain factors - the presence of forests, a complex spatial pattern of soil

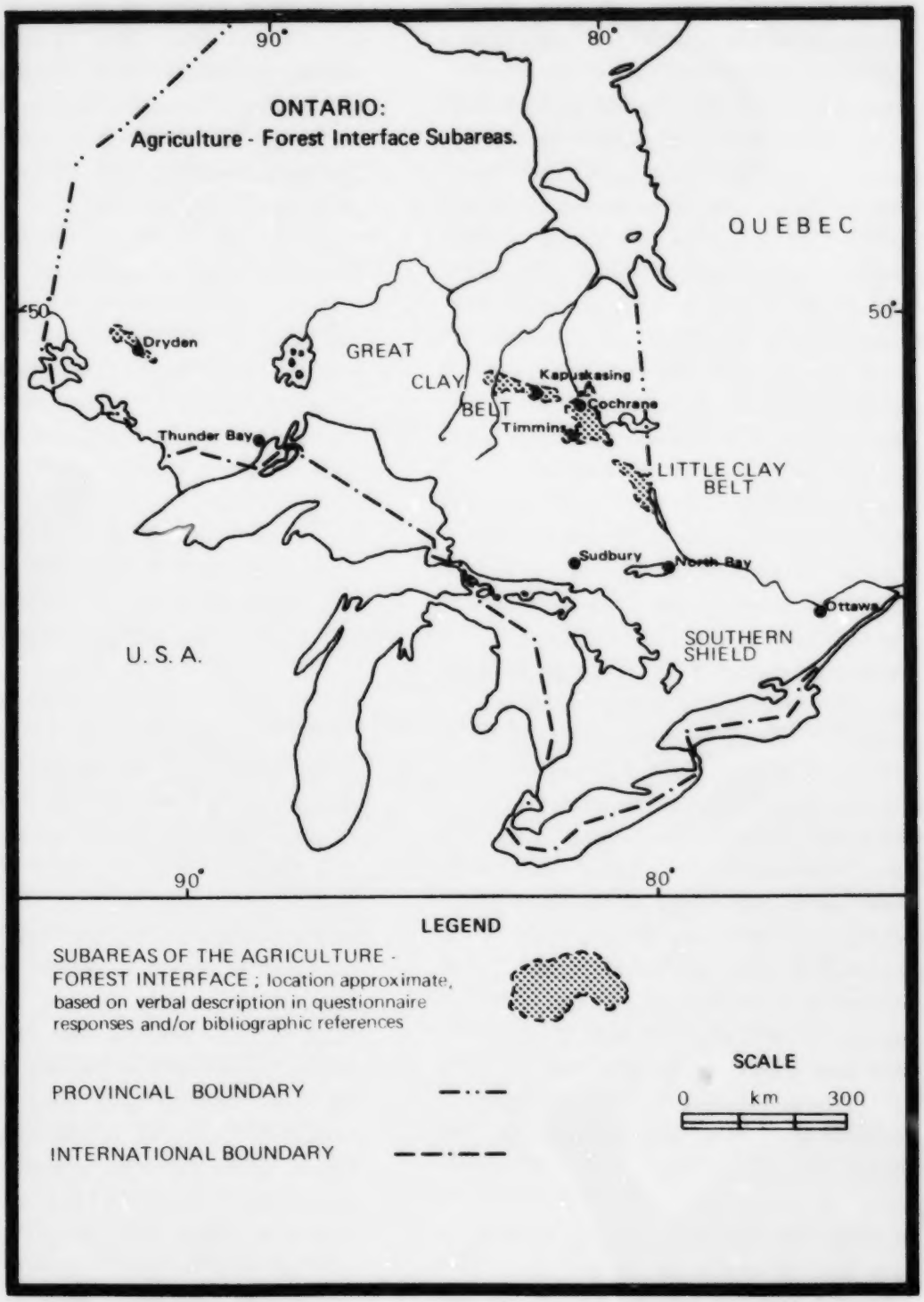
ONTARIO:
Agriculture - Forest Interface Subareas.
90°
80°
50°
QUEBEC
Dryden
GREAT
CLAY
BELT
Kapuskasing
Cochrane
Timmins
Thunder Bay
LITTLE CLAY
BELT
Sudbury
North Bay
Ottawa
U. S. A.
SOUTHERN
SHIELD
LEGEND
SUBAREAS OF THE AGRICULTURE - FOREST INTERFACE ; location approximate, based on verbal description in questionnaire responses and/or bibliographic references
SCALE
0 km 300
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY

**FIGURE 6.**

types, and poor soil drainage - present more serious limitations. Even so, the capability of the Clay Belt to support more widespread agriculture than at present, irrespective of intensity and productivity, is not questioned. The major issue really concerns the identification of conditions, such as future changes in market conditions for food or changes in land supply in both marginal and non-marginal areas, that will need to be met before the Clay Belt's potential will be tapped (M. Brklacich, pers. comm., 1983). Having recognised a need to establish a reserve of agricultural land that could be drawn on if future needs warrant (Ontario Ministry of Natural Resources, 1980b), the main task is then to identify the lands to be included in the reserve and specify the interim use to which they should be put. Such lands in the Clay Belt have CLI agricultural capability classes 3 or 4 and for the most part are currently in productive forest cover although forestry capability is limited to classes 4 and 5 at best. Clearly there is a risk associated with investment in timber management in the lands reserved for agriculture, because the areas may be drawn into agricultural use before the timber crop matures. In northeastern Ontario almost 108,000 hectares, in addition to over 180,000 hectares of existing improved farmland, have been identified for possible agricultural expansion to the year 2000 (Ontario Ministry of Natural Resources, 1982a).

Although the Clay Belts largely represent land that is surplus to current needs, a potential conflict between agriculture and the removal of aggregate may occur where aggregate is in short supply (Ontario Ministry of Natural Resources, 1982). In parts of the Great Clay Belt aggregate removal may be considered a higher priority use because alternative sources of farmland are in greater supply than alternative aggregate sources. Such conflicts are likely to be highly localised.

The Sudbury region lies within the general agriculture-forest boundary zone but has conflicts in land use which do not involve a major direct interaction between the two principal land uses of the zone. Concerns that are current in the Sudbury region include conflicts between

- urban and agricultural land uses
- resource extraction and conservation
- recreation and resource extraction
- public and private recreation.

(T. Wu, pers. comm., 1983)

In addition, acid rain largely originating from nickel smelters has had a deleterious effect on both the forest and agricultural land bases.

Farm abandonment along the southern edge of the Canadian Shield in central Ontario has been well documented (Parson, 1979). A key issue in such areas has been related to easing the movement of farmers away from the land. Farming is unlikely to be viable in most of this area in the forseeable future, given physical, economic and social conditions. The Shield does not have the same agricultural potential as the Clay Belt and thus it seems inappropriate to earmark any substantial areas of land on the Shield for farming in the future.

However, rising urban population in southern Ontario has brought increasing demands for recreational land. Other activities on the Shield include forestry and wildlife management and local conflicts between various land use combinations have arisen. The major shifts out of agriculture occurred before 1971; currently the area is one of more modest change.

Governments have been involved periodically in attempts to influence land use in the agriculture-forest interface of Ontario. In the 1960s the federal government's Agricultural Rehabilitation and Development Administration had an objective to increase the standard of living in marginal agricultural areas. This program was largely abandoned in the 1970s and there remained hardly any federal or provincial government policy to support agriculture in northern Ontario. The Ontario Ministry of Agriculture and Food maintains research facilities and extension services, and northern farmers have access to conventional agricultural programs. However, it is not the intent of such programs to sustain northern agriculture by direct or indirect means (Troughton, pers. comm., 1983).

The provincial government has been involved in land use planning throughout the study period. In the early years most of the plans prepared were single sector plans. Over the past ten years the concept of the "strategic land use plan" has emerged. Such plans state in broad terms the policy of the Ministry of Natural Resources with respect to land use in Ontario and they serve as a guideline for coordinating the government's various land use programs. Strategic Land Use Plans for northwestern and northeastern Ontario, where most of the land and water is publically-owned Crown land, administered and managed by the Ministry of Natural Resources, were released in 1982 (Ontario Ministry of Natural Resources, 1982b). Conflicting demands for land and water in each planning region are recognised and solutions are suggested. The plans also provide an overall strategy for guiding the finer planning details at the district level. Plans at the latter level are currently being prepared. In general Strategic Land Use Plans are based on the concept of multiple use. As previously discussed, the plans generally reinforce the government's commitment to protect lands of high agricultural capability in all parts of the province. Forest reserves have been established, although they must be justifiable in a multiple use concept. Crown land will be made available for development and private initiative.

The Clay Belts comprise the main sub-area of the agriculture-forest interface in Ontario. The chief concern over the last thirty years has been the economic and social impact of farmland abandonment, whereas currently the primary planning issue is the allocation of land for anticipated future use. In particular, the Clay Belts constitute a supply of agricultural land held largely in forest cover that might be drawn into farming use if future demand arises.

## 2.6 Quebec

In common with Ontario, there is a general tendency in Quebec for agriculture at its interface with forested areas to be in retreat, especially in western parts of the province, the Beauce, the northern shore of the St. Lawrence River and the Gaspé Peninsula (Mandale, 1984). Between 1951 and 1971 the total Quebec area in farms decreased by over one-third, but unimproved land, especially at the margins, decreased by 45 percent, compared with only a 27 percent loss of improved farmland (McGill University, 1973). Although similar social and economic pressures to give up farming in marginal areas face both the Quebec and Ontario farmer, different legislative measures have caused, periodically, rather different land use trends to emerge. For example, between the end of the Second World War and 1961, Ehlers (1974) noted that while the cultivated area in the Ontario Clay Belt declined slightly, in the Quebec section cultivated land increased by 27 percent. Clay Belt agriculture in Quebec was sustained in part by a strong commitment by the provincial government to subsidised milk production.

Substantial land use change has been identified in five areas of Quebec's agriculture-forest boundary zone (Figure 7). These five sub-areas include, in order of priority: the Beauce; two sub-areas in the Eastern Townships centred on Granby and Sherbrooke; Huntingdon; and Vallée de la Matapédia in the Gaspé (Melançon, pers. comm., 1983). All of these areas have soils that are marginal from an agricultural standpoint (CLI classes 4 and 5) and in four of the five areas the main trend has been towards reforestation of former agricultural land. The exception is provided by the Huntingdon sub-area where two trends are apparent. Melançon has noted that peatlands, covering approximately one-fifth of the area, are being converted to the production of vegetables, especially potatoes and onions. In addition a more general trend of agricultural expansion at the expense of forest land has been noted since the passing of the Act to Preserve Agricultural Land in 1978 (Gerard, pers. comm., 1983), a piece of legislation that is discussed later.

Additional areas of land use change have been identified, including the regions north and south of both Montreal and Quebec City (Leduc and Gravel, pers. comms., 1983) and to a lesser extent the peripheries of Drummondville, Sherbrooke, Saint-Hyacinthe, Chicoutimi, Rimouski (Leduc, pers. comm., 1983), Trois Rivières (Leduc and Gravel, pers. comms., 1983) and the Lac-St-Jean basin (Lemieux and Gauthier, pers. comms., 1983). A conflict noted by questionnaire respondents in most of these areas is between residential development and agriculture and forest uses. Changes in the Lac-St-Jean basin are largely associated with timber harvesting which is proceeding at a high rate because of the strong demand for wood products.

The primary land supply issue probably focusses on timber land rather than farmland. There is a concern to secure the source of supply for timber mills (Gerard, pers. comm., 1983). This does not simply involve ensuring that enough forest land is set in reserve, but that sufficient timber resources are available in the appropriate

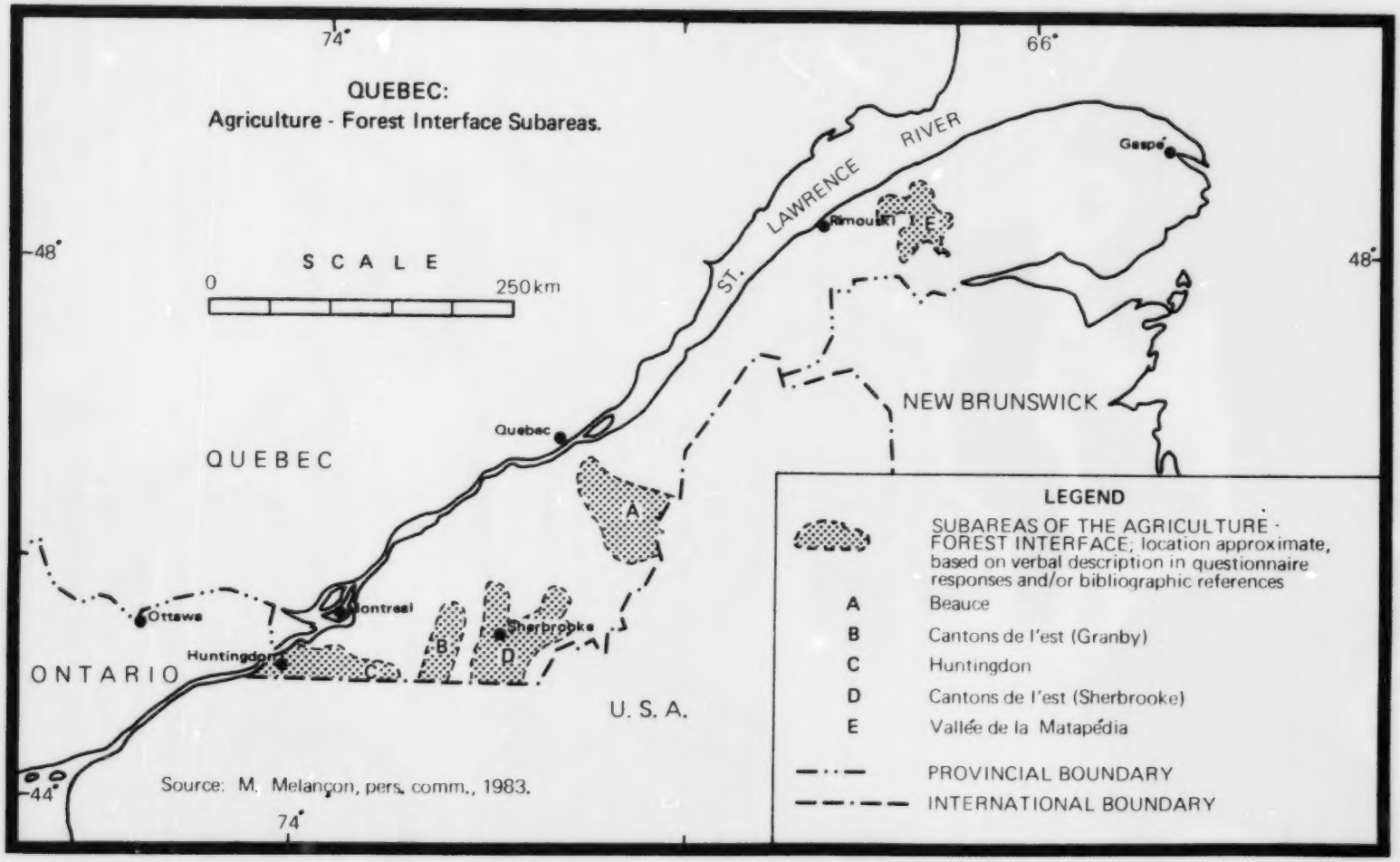
QUEBEC:
Agriculture - Forest Interface Subareas.
74°
66°
48°
44°
SCALE
0
250 km
ST. LAWRENCE RIVER
Gaspé
Rimouski
E
NEW BRUNSWICK
Quebec
QUEBEC
A
Ottawa
Montreal
Sherbrooke
Huntingdon
B
C
D
ONTARIO
U. S. A.
Source: M. Melançon, pers. comm., 1983.
LEGEND
SUBAREAS OF THE AGRICULTURE - FOREST INTERFACE; location approximate, based on verbal description in questionnaire responses and/or bibliographic references
A Beauce
B Cantons de l'est (Granby)
C Huntingdon
D Cantons de l'est (Sherbrooke)
E Vallée de la Matapédia
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY

FIGURE 7.

location. Sawmills have been closed in the Gaspé Peninsula because their timber supply became progressively more distant, to the point where it became uneconomical to transport it to the plant (Gerard, pers. comm., 1983).

In an effort to address these concerns, the Quebec government recently approved a major expansion of its Crown land reforestation program. The program is currently in the planning stage, with the anticipation tnat it will be implemented in the summer of 1985.

Strong provincial legislation has assured the supply of agricultural land although some mild concern has been expressed that the Crown lands reforestation program will involve some land of high agricultural capability (Gerard, pers. comm., 1983). Agricultural lands in the St. Lawrence Valley, the Gaspé Peninsula, the Lac-St-Jean and Saguenay region and the Abitibi-Temiscaming area come under the jurisdiction of the Commission de protection du territoire agricole which administers the Agricultural Land Protection Act. In effect since 1978, this Act prohibits, within the protected zones, the removal of land from agricultural use, subdivision of lots and removal of topsoil without the permission of the commission. Not only is agricultural use of the land preserved but also an attempt is made to maintain the viability of farming operations by prohibiting all activity that is incompatible with agriculture. Thus farmland supply has largely been assured, but the limitations and restrictions which the legislation imposes on private land owners remains a concern (Gerard, pers. comm., 1983).

Five primary agriculture-forest sub-areas in Quebec have been identified, located mainly in areas peripheral to the agricultural heartland. A key land resource issue in the province is maintenance of the farmland base, especially high capability lands. Concern has been so acute that strong legislation to protect such lands is now in place. Although the dominant land use trend in the agriculture-forest interface areas of Quebec is the reversion of former agricultural land to forest, one key provincial issue yet to be addressed concerns an adequate supply of accessible timber for the province's mills.

## 2.7 New Brunswick and Nova Scotia

Agricultural land use in New Brunswick and Nova Scotia differs in three ways from such land use in most provinces to the west, a feature which has implications for identification of agriculture-forest interface sub-areas in Nova Scotia and New Brunswick. First, the agricultural land base of these eastern provinces is relatively small: New Brunswick and Nova Scotia had 191,931 hectares and 177,982 hectares respectively of improved farmland in 1981, compared with Ontario's 4,518,552 hectares. While there are substantial amounts of land with moderate agricultural capability (classes 3 and 4), it occurs in small, scattered blocks (Nowland, 1975; Mandale, 1984) which hinder the development of viable farm units. Given the small farmland base, there is limited potential for continued contraction of agriculture.

Second, the period of most rapid farmland abandonment was from 1951 to 1961; since then, rates of land use change have been relatively modest but significant locally. Although percentage changes from one land use category to another have been great in the past, the absolute area of land changing use has been small compared to provinces with larger agricultural land bases. The third difference between Nova Scotia and New Brunswick and provinces to the west concerns the distribution of land use changes within the province. Changes in the Maritime provinces have not been as localised as they have in other provinces, but instead have occurred in widely scattered areas (Mandale, 1984). Thus it is not possible to identify sub-areas of substantial land use change within agriculture-forest interface. Rather, most areas of the provinces are within the agriculture-forest interface in which the reversion of farmland to forest has been widespread.

The trend of once-cleared land reverting to woodland, so strong in the 1950s and 1960s, has largely ended and in some places in New Brunswick land clearing is taking place, although reversion is still occurring in others (New Brunswick Land Use Policy Task Force, 1982). Recent clearing, for example, has taken place in northeastern New Brunswick, especially in Gloucester County which has experienced a considerable increase in blueberry hectarage. However, although clearing continues in widely scattered areas, some previously cleared lands are still not being utilised for agriculture (M. Dillon, pers. comm., 1983). This situation is partly attributable to non-resident ownership of farms and partly because some of the land that has been cleared relatively recently has proven to be of low agricultural quality. Grants for land clearing and drainage throughout the province have been available through Agricultural Sub-Agreements made between the provincial and federal governments.

Although some conflicts between agricultural and forestry interests have arisen, the main conflict in New Brunswick is between residential development and primary activity (New Brunswick Land Use Policy Task Force, 1982). The general regions of such conflicts are, according to the New Brunswick Land Use Task Force (1982), the rural areas of the province, lying outside the Crown lands and urban areas. Such rural areas cover about half the province and, being unincorporated, lack effective community plans and resource strategies to deal with such issues. Thus the major conflict is focussed on the use of private land, as opposed to Crown lands, which form the focus of land resource allocation problems in western provinces.

Similar issues exist in Nova Scotia. The area in census farms declined remarkably from 1.74 million hectares in 1931 to 0.53 million hectares in 1971. Such losses of farmland were highest at the forest's edge in poorer agricultural areas, particularly where the farmed area was relatively small (Crickmer, 1981). At the farm level, land abandoned first was typically that farthest from the farmstead (Kienholz, 1983). Typically, abandoned farmland reverted to bush (R.E. Bailey, pers. comm., 1983). At present competition between agricultural

and forestry interests is not a prevalent issue in Nova Scotia (D. Smith, pers. comm., 1983), although, in common with New Brunswick, some land clearing has been recently funded through Agricultural Sub-Agreements and since 1976 drainage schemes have been implemented.

Land use conflicts in Nova Scotia are generally of local, rather than provincial, significance. Schori (1983) identified several such examples: farming along rivers and estuaries may not be compatible with fisheries; farm drainage problems result from highway construction, and drainage and dykeland protection may be difficult when non-agricultural activities use such lands. In addition, recreational land uses have invaded the shorelines of many parts of the Maritimes (Mandale, pers. comm., 1983).

A major constraint in land resource allocation in Nova Scotia is fragmentation of land ownership into small parcels, reflecting its long history of settlement. As in New Brunswick, a major issue surrounds private rather than public land. Farmland which has been abandoned in Nova Scotia represents future agricultural potential but it is typically on small private holdings and decisions as to its future use are in the hands of the individual landholder. It has been suggested that land tenure patterns could be one of the most significant problems faced in consolidating farms into economically viable units and in expanding Nova Scotian agriculture (Nova Scotia Land Use Data Issue Group, 1982). Fragmentation of land ownership is also incompatible with forest management objectives. Private land-owners have removed large areas from future forest production by retaining land in its natural state for recreational purposes such as cottaging (J.D. Smith, pers. comm., 1983).

A range of legislation and government programs has had limited influence on land use in New Brunswick and Nova Scotia. However, some programs have had a direct impact on land use. For example, the Agricultural Sub-Agreement II, providing subsidy for land clearing and drainage, has contributed to an increase in the farmland base. In other cases, the impact has been indirect. In Nova Scotia, the new planning act permits subdivision of land parcels over 10 hectares without a legal survey (Schori, 1983). While the effect of this legislation has yet to be felt, it may encourage subdivision of lots slightly greater than 10 hectares. This has the potential of increasing land fragmentation and substantially reducing the farmland base, considering the prediction that 22,000 homes will be built in Nova Scotia's rural municipalities in the 1980s (Schori, 1983). As pointed out previously, however, private land owners occupy much of the rural area, over which provincial legislation has little direct influence.

Over the past decade, the increasing complexity of resource development needs within New Brunswick has prompted several major studies involving both agriculture and forestry. The consensus of resulting reports has been recognition of the need for a provincial land use policy and a coordinating body to assess the effects of government programs on land use (New Brunswick Land Use Policy Task Force,

1982). To meet these needs the Land Use Policy Task Force has recommended the establishment of both a land resources development office to coordinate the government's land resources development programs and a rural area development policy to "combine the desires of the citizens, the potential of the land resources and government programmes within an effective administrative framework" (New Brunswick Land Use Policy Task Force, 1982).

The agriculture-forest interface is spread throughout much of New Brunswick and Nova Scotia, although no obvious sub-areas of substantial land use change are identifiable. The major land use concerns relate to privately held rural held rural land in each province where there is a conflict between residential development and primary production. Fragmentation of land ownership poses problems for the expansion and management of both agricultural land forest lands at viable scales of production. There is little legislative control over land use in such areas and yet they contain the major potential additions to both the agricultural and forest land bases.

## 2.8 Newfoundland

Less than 0.3 percent of Newfoundland's land base - about 100,000 hectares - is considered capable of supporting agriculture, and only 8,000 hectares of that total are currently in commercial agricultural production (R. Warren, pers. comm., 1983). Most of the island consists of woodland, moorland and wetland. The limited extent of the agricultural land base calls into question the applicability of the agriculture-forest interface concept in the province because the scale of past changes has been even smaller in Newfoundland than in either New Brunswick or Nova Scotia. Furthermore, the areas with agricultural capability are small and widely dispersed, much as the small farming outliers north of the forest-agricultural boundary on the mainland. Nevertheless the issue of competition between agriculture and forestry has been identified in several areas, which are outlined in Figure 8 (R. Warren, pers. comm., 1983). Locally, recreation places an additional demand on the land resource base.

Although little of the province has been cleared, the current demand for certain forest products is not being fully met. For example, a forestry management problem exists in the central portion of the Avalon Peninsula where recreational and agricultural demands for land have exerted pressure on relatively high quality forest land and the strong demand for firewood and sawlogs currently exceeds the annual allowable cut.

A major constraint on forest management throughout the province is the lack of delineation of prime forest land to be reserved for forest harvesting (Newfoundland and Labrador. Department of Forest Resources and Lands, 1983). Once identified, high capability forest land could be protected from competing land uses.

Increasing pressures on the province's best agricultural areas from activities such as residential, commercial and industrial development, recreation and sod and topsoil removal, has prompted the provincial government to implement a program for identification and preservation of

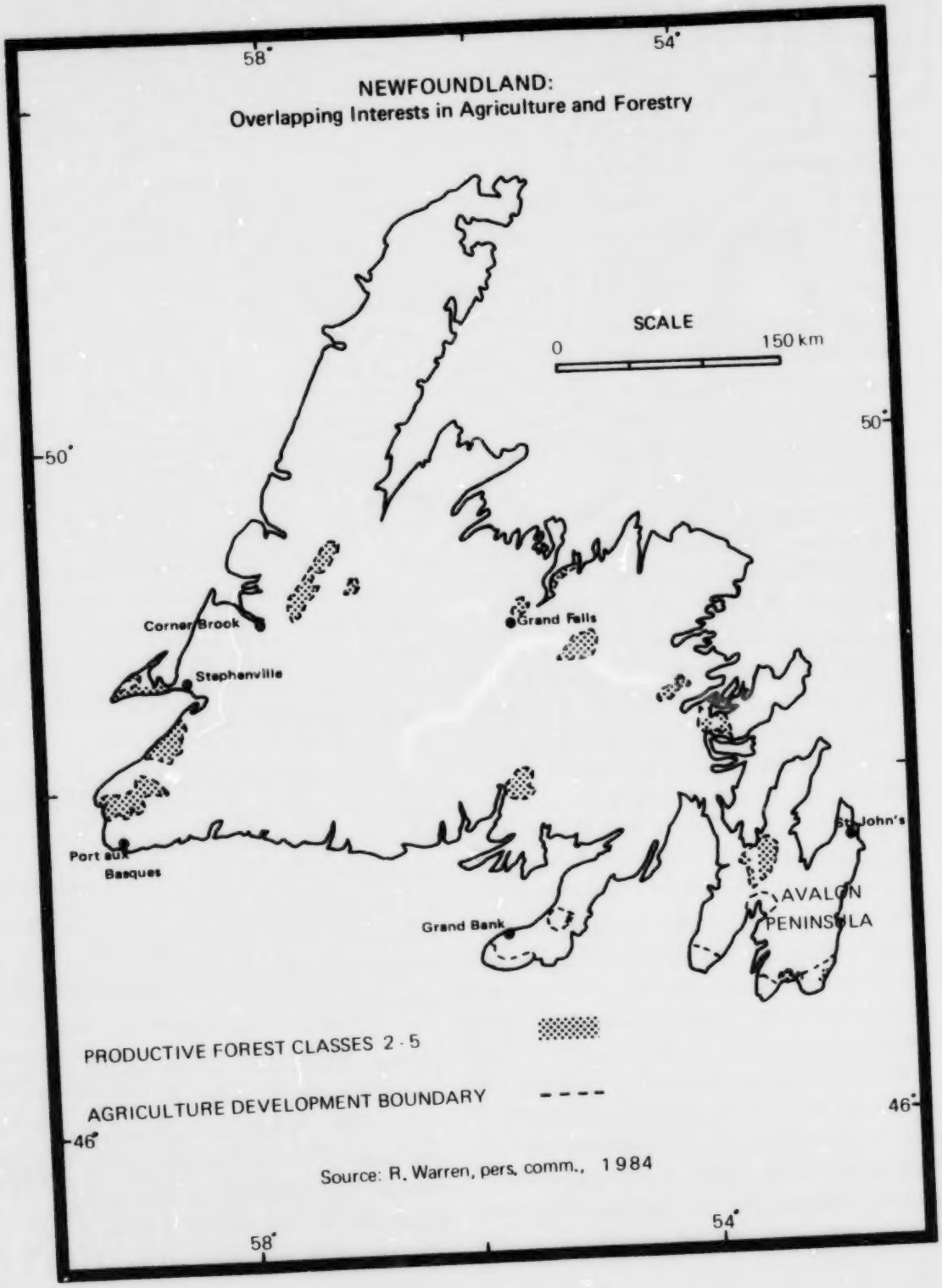
NEWFOUNDLAND:
Overlapping Interests in Agriculture and Forestry
58°
54°
50°
46°
SCALE
0
150 km
Corner Brook
Stephenville
Grand Falls
Port aux Basques
Grand Bank
St. John's
AVALON PENINSULA
PRODUCTIVE FOREST CLASSES 2 - 5
AGRICULTURE DEVELOPMENT BOUNDARY
Source: R. Warren, pers. comm., 1984

FIGURE 8.

agricultural lands (R. Warren, pers. comm., 1983). The major areas with farming potential have been designated Agriculture Development Areas, based on studies of assessment of land capability, present land use, land ownership and socio-economic status in relation to agriculture. Zoning regulations either restricting or tightly controlling land uses not compatible with agriculture have been imposed on these areas. The intent of these regulations is to protect potential agricultural areas from conversion to activities that would preclude future use of the land for agriculture.

In addition to the single sector plans for agriculture, the Lands Management Division of the Department of Forest Resources and Lands has introduced a Crown land planning program with the objective of developing integrated land management on the province's Crown lands. In some areas, Crown Land Plan zones and Agricultural Development Areas (ADAs) overlap, as in the case of the proposed Markland-Whitebourne ADA and the Central Avalon Crown Land Plan area. To date, however, an agricultural development plan has not been prepared and conflicts have not been resolved, although both an agricultural policy and a forest policy are proposed in the plan (Newfoundland, Department of Forest Resources and Lands, 1984). The agricultural policy seeks, among other things, to protect Crown land adjacent to existing farms from encroachment of activity that may affect viability of the farms. On the other hand the forest policy seeks the establishment and protection of the forest land base, although agricultural expansion at the expense of forest land might be allowed to ensure the continuing viability of a farm.

The Southern Shore Crown Land Plan covers approximately half the southeastern peninsula and as in the Central Avalon area, an Agricultural Development Area overlaps the Crown land plan area. As an agricultural development plan has not yet been prepared, the Crown land plan is intended to provide interim control. The plan protects soils with high to moderate agricultural capability (CLI classes 3 to 5) for uses, not necessarily agriculture, to be determined in the future. Even lands reserved for long term forestry use may be used for other purposes if there is a substantial change in prevailing economic or political conditions (Newfoundland and Labrador, Department of Forest Resources and Lands, 1983).

Although farming in Newfoundland is small scale and restricted to a series of isolated locations, competition between agriculture and forestry exists in several areas. Recreational demands exert an additional local pressure on land. The need to identify and protect high capability forest and farm-land for possible future use has been recognised through the establishment of Agricultural Development Areas and the principles espoused in the province's Crown Land Plans.

## 2.9 Summary of Areas and Issues

A series of geographic areas undergoing substantial land use change within the agriculture-forest interface have been identified on the basis of a literature search and the perceptions of land resource planners and researchers surveyed across

Canada. Provinces whose sub-areas exhibit the most marked land use changes include British Columbia, Alberta and Manitoba where the general trend has been expansion of agriculture at the expense of the forest land base, and Ontario and Quebec where the farmed areas have been contracting and abandoned fields have been reverting to forest. In most cases the sub-areas are on the northern fringe in relatively isolated locations. In British Columbia, however, many of the valley floors exhibit characteristics of the agriculture-forest interface, resulting in a linear network of sub-areas extending from relatively accessible valleys in the south to more isolated areas in the centre of the province.

The scale of land use change in other provinces has been smaller than in those provinces discussed above. Although the agricultural frontier in Saskatchewan is considered closed, limited agricultural expansion has occurred locally. Land with agricultural capability in New Brunswick, Nova Scotia and Newfoundland is limited in area and widely dispersed. Historically each province has experienced considerable farmland abandonment, but the process has been widespread and most parts of each exhibit some characteristics of the agriculture-forest interface.

A summary of issues prevalent in each of the provinces is shown in Table 1(a) and (b). The issues associated with any one province are those explicitly identified by the sources that were consulted and thus the list should not be regarded as exhaustive. Despite the very different character of land use change in the agriculture-forest sub-areas across the country similar land management concerns were voiced in both eastern and western Canada (Table 1(a)). Clearly, the adequacy of both the agricultural and forest land bases is regarded as an important issue nationwide, as also is the concern to preserve the capability of the land whether for forest or agriculture. Issues of forest land management were accorded attention, particularly the maintenance of sustained yield in British Columbia and the east, and management for multiple use in Ontario and the west. Fragmentation of land ownership proved to be a key issue in New Brunswick and Nova Scotia.

There is a marked distinction between land allocation issues in eastern and western parts of the country. Whereas the main concern in the west focuses on the extension of marginal agriculture on to medium to high capability forest land, in the east farmland abandonment and the resultant underutilisation of land are the primary land allocation issues. This situation is not surprising, given the prevailing trends in land use across the country. The most pressing land allocation issues occur in British Columbia, Alberta and Manitoba where competition for land is most intense and there is pressure to commit land to specific uses over the short term. In the east, the need to allocate land does not appear as urgent, although the existence of extensive tracts of abandoned farmland slowly reverting to non-commercial bush is perceived as an issue of idle or underutilised land.

Land resource conflicts (Table 1(b)) appear more complex in western Canada than in the

TABLE 1(a)

LAND MANAGEMENT AND LAND ALLOCATION ISSUES IN THE AGRICULTURE-FOREST INTERFACE ZONE: A PRELIMINARY LIST

| Issues of Land Management and Land Allocation | AREA | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | West | | | | East | | | |
| | B.C. | Alta. | Sask. | Man. | Ont. | Que. | N.B./ N.S. | Nfld. |
| **Land Management** | | | | | | | | |
| Agriculture - adequate land base | * | ** | | * | ** | * | * | ** |
| - preserve capability | * | * | * | | * | * | * | * |
| Forestry - adequate land base | ** | * | | * | * | ** | * | * |
| - maintain sustained yield capability (reforestation) | * | | | | * | ** | ** | |
| - manage for multiple use | * | * | * | ** | * | | | |
| - stability of forest boundary | | * | | | | | | * |
| Fragmentation of ownership | | | | | | | ** | |
| Integrated Resource Management (timber/range) | * | * | | | | | | |
| **Land Allocation** | | | | | | | | |
| Agriculture - land abandonment | | | | | * | ** | ** | |
| - land left idle or underutilised | | | | | ** | * | * | |
| - extension on low capability land | * | ** | * | ** | | | | * |
| Forest - clearance of high capability forest land for farming | ** | | | | | | | |
| - reclaim marginal agricultural land to productive woodland | | | | | * | * | * | * |

*Issues mentioned.

**Most predominant issues.

Sources: Questionnaire and bibliographic survey.

TABLE 1(b)

ISSUES OF LAND RESOURCE CONFLICT: A PRELIMINARY LIST

| Land Use | Agriculture | Forest | Wildlife |
|---|---|---|---|
| Forest | land clearance<br>B.C.*, Alta.*, Sask.*, Man.*, Que., Nfld.<br><br>farm abandonment<br>Ont., Que., N.S./ N.B., Nfld. | | |
| Wildlife | Land clearance<br>B.C., Alta., Sask., Man*<br><br>wetland drainage<br>Sask, Man.* | clearcutting<br>B.C., Man. | |
| Watershed Protection | land clearance<br>B.C., Alta. | clearcutting<br>B.C.*, Alta. | |
| Recreation | recreation facilities<br>Alta. | recreation facilities<br>B.C., Alta., Sask., Man., Ont., N.B./ N.S., Nfld. | recreation facilities<br>Ont. |
| Settlement | urban growth<br>B.C., Alta., Que., N.S./ N.B., Nfld. | urban growth<br>B.C., Alta. Que., N.B./ N.S. | transportation<br>Sask. |
| Extraction Minerals/ Energy | hydro-installations<br>B.C., Alta., Sask, Man.<br><br>gas/oil installations<br>Alta.<br><br>aggregate<br>Ont. | hydro-installation<br>B.C., Alta. Sask., Man.<br><br>gas/oil installation<br>B.C., Alta., Sask. | gas/oil installations<br>Alta., Sask. |

*Areas where issue is acute.

Source: Questionnaire and bibliographic survey.

eastern part of the country. The impact of land clearance for agricultural purposes on forest, wildlife and watershed protection is emphasised for most of the Prairie Provinces and British Columbia, although the impact of agriculture on forestry has also been felt in Quebec and Newfoundland. The detrimental effect of forestry activities, such as clear cutting, on wildlife populations and watershed protection is curiously only regarded as an issue in British Columbia and Alberta, despite the fact that such operations are undertaken in every province. Conflicts between, on one hand, largely urban-generated demands - recreation, settlement and energy and mineral resource extraction - and, on the other hand, forestry and agriculture occur from coast to coast. The impact of recreation on forestry was mentioned as an issue in all provinces except Quebec, although commonly the impact is localised. The negative impacts of urban growth and resource extraction on agriculture and forestry are also usually quite localised, but the capability of this land for agricultural or forestry use is often quite high.

Finally the complexity of land-related issues should be underscored. For purposes of generalisation and convenience, Table 1 divides issues into land management, land allocation and land use conflict categories. In reality, these three themes are highly interrelated and decisions of one type, such as land allocation, have potential implications for both land management and land use conflicts.

## 3.0 INFORMATION SOURCES FOR THE STUDY OF THE AGRICULTURE-FOREST INTERFACE

If land use changes in the agriculture-forest interface are to be monitored and studied on a more comprehensive and systematic basis than has been the case in the past, reliable information on land use at different points in time is required. In this section, sources of data pertinent to the study of land use change in the agriculture-forest interface are reviewed and evaluated, and deficiencies are noted where relevant. The information sources are presented in three categories: (1) air photos and remote sensing imagery; (2) land resource data bases and maps; and (3) research and planning studies and activities. While a concerted effort was made to identify available information sources, this section should not be considered a definitive outline of all data sources and research, both ongoing and completed, regarding land use change at the agriculture-forest interface. One difficulty in obtaining a comprehensive list of sources concerns the widely dispersed nature of such potential data sources. In addition, the agriculture-forest interface has not been previously conceptualised and in some cases respondents to questionnaires indicated a lack of clear understanding of the concept, particularly regarding the nature and scale of the areas of interest.

### 3.1 Airphotos and Remote Sensing Imagery

The value of sequential aerial photography for the identification of land use change is well documented (Paine, 1979). In order to assess the availability of aerial photographs for the potential of monitoring land use change at the agriculture-forest interface, 1961-1981, indexes of aerial photographs from provincial and federal governments, as well as private company sources, were reviewed. A listing of these sources is contained in Appendix 2.

The coverage of all types of photography flown at scales between about 1:20,000 and 1:60,000 during the 1960-1962, 1970-1972 and 1980-1982 periods was noted. These time periods were selected to ensure that information on land use derived from aerial photography would coincide closely with socio-economic data from the decennial census. Three year periods were chosen to increase the available photographic coverage. Information on available provincial and federal government photographic coverage is summarized in Tables 2 and 3 and Figures 9 to 14.

Certain factors should be noted before reviewing the air photo coverage. The format of the index maps from provincial sources in British Columbia made it impossible to ascertain the provincial government coverage for the 1960-1962 time period and difficult to determine all coverage in the 1970-1972 time period. A considerable portion of the study area of Alberta was flown by the province at a scale of 1:60,000 during the 1970-1972 and 1980-1982 time periods. It is estimated that the available coverage for these time periods could be increased to approximately 75 percent provided photography at this scale could be utilized for monitoring purposes. Similarly small scale photography (1:80,000) is available for much of Saskatchewan for the 1970-1972

TABLE 2

AGRICULTURE-FOREST INTERFACE ZONE: FEDERAL AND PROVINCIAL GOVERNMENT AIR PHOTO COVERAGE (%) AT SCALES BETWEEN 1:20,000 and 1:60,000.

| | British Columbia | Alberta | Saskat-chewan | Manitoba | Ontario | Quebec | Nova Scotia | New Brunswick | New-foundland |
|---|---|---|---|---|---|---|---|---|---|
| 1960-1962[a] | 2%c | 16% | 4% | 45% | 23% | 19% | 9% | 67% | 0% |
| 1970-1972 | 39% | 34% | 37% | 25% | 57% | 62% | 62% | 74% | 6% |
| 1980-1982 | 13% | 23% | 31% | 38% | 27% | 62% | 38% | 31% | 56% |
| Total area[a] covered all time periods | <1% | 1% | <1% | 2% | 5% | 6% | 5% | 11% | 0% |
| Total area[b] covered by both 1970-72 and 1980-82 coverage | 5% | 10% | 15% | 5% | 12% | 50% | 20% | 20% | 1% |

a Percentage coverage calculated by use of a dot matrix grid overlay on the maps of air phot coverage compiled.
b Percentage coverage"eyeballed" by comparing the maps of airphoto coverage for the respective time periods.
c Provincial coverage unknown.

Source: See Appendix 2

TABLE 3

AGRICULTURE-FOREST INTERFACE ZONE: AREAS WITH AERIAL PHOTOGRAPHIC COVERAGE

(a) Coverage at all periods: 1960-1962, 1970-1972 and 1980-1982.

| Province | 1:250,000 NTS map sheet[a] | Location |
|---|---|---|
| British Columbia | 93B, 92O (very small area) | Williams Lake |
| Alberta | 84F | north of Manning |
| | 83M, 83N | Grande Prairie to High Prairie |
| | 83O | Lesser Slave Lake |
| Manitoba | 62N | West Shore Lake Winnipegosis |
| | 62I | north of Winnipeg |
| | 63F | The Pas |
| Ontario | 41J | Sault St. Marie |
| | 41I | east of Sudbury |
| | 31L | Temiscaming |
| | 31D | Alliston, west of Lake Simcoe |
| Quebec | 31I, 21L, 21M, 21N | Lower St. Lawrence: Trois Rivières to Rivière du Loup |
| New Brunswick | 21O, 21P | Campbellton, Bathurst |
| | 21G | Lower Saint John River |
| Nova Scotia | 20P | Yarmouth |
| | 11D | Halifax |

(b) Coverage at two periods: 1960-1962 and 1980-1982.

| | | |
|---|---|---|
| British Columbia | 93B, 92O (very small area) | Williams Lake |
| Alberta | 84F | north of Manning |
| | 83M, 83N, 83O | Grande Prairie to High Prairie |
| Manitoba | 63G, 63B (all) | North Interlake |
| | 62O | Interlake Gypsumville |
| | 63C | Swan River |
| Ontario | 41J | Sault St. Marie |
| | 41I | Sudbury |
| | 31L | Temiscaming |
| | 31D | Alliston |
| Quebec | 31I, 21L, 21M, 21H | Trois Rivières, Quebec City, Rivière du Loup |
| | 21E | east of Sherbrooke |
| New Brunswick | 21O, 21P | Campbellton |
| | 21G | Lower Saint John River |
| | 21H, 21I | Moncton |
| Nova Scotia | 20P | Yarmouth |
| | 21A | Bridgewater |
| | 11D | Halifax |

(c) Coverage at two periods: 1970-1972 and 1980-1982

| | | |
|---|---|---|
| British Columbia | 94B, 93O | Williston Lake north of Prince George |
| | 93L | Smithers |
| | 93G | south of Prince George |
| | 94A | west of Fort St. John |
| | 82L | Revelstoke |
| | 82F, 82G | Kootenays |

a Usually coverage of a small part of the map sheet unless otherwise specified.

TABLE 3 CON'T

(c) Coverage at two periods: 1970-1972 and 1980-1982 (continued)

| Province | 1:250,000 NTS map sheet* | Location |
|---|---|---|
| Alberta | 84L | west of Fort Vermillion |
| | 84F | north of Manning |
| | 84B | east of Peace River |
| | 83K, L, M, N, O | Grande Prairie to High Prairie |
| | 82G | Eastern Slopes |
| | 82O | north of Calgary |
| | 83J | northwest of Edmonton |
| Saskatchewan | 63E | Carrot River |
| | 63D (all) | Hudson Bay |
| Manitoba | 63C | Porcupine Hills |
| | 61I | north and east of Winnipeg including part of Winnipeg River |
| Ontario | 41J | Sault St Marie |
| | 41I | Sudbury |
| | 31L | North Bay, Temiscaming |
| | 31D | Peterborough |
| | 31F | Pembroke |
| | 52F | Kenora |
| | 31M | Haileybury |
| Quebec | 22G | Cap Chat |
| | 32A, 22D | Lac St Jean, Chicoutimi |
| | 22C | Rimouski |
| | 22B | Matapédia |
| | 21H, 31I, 21L | Rivière du Loup, Quebec, Trois Rivières |
| | 31J, 31K | Maniwaki, Mont Laurier |
| | 31H | Montreal |
| | 32C, 32D | Noranda, Val d'Or |
| New Brunswick | 21O | Campbellton |
| | 21G | Lower Saint John River |
| | 21H, 21I | Moncton |
| Nova Scotia | 11D, 11E | Halifax, Truro |
| | 20P | Yarmouth |
| | 21A | Annapolis |
| Newfoundland | 1H | St. John's |

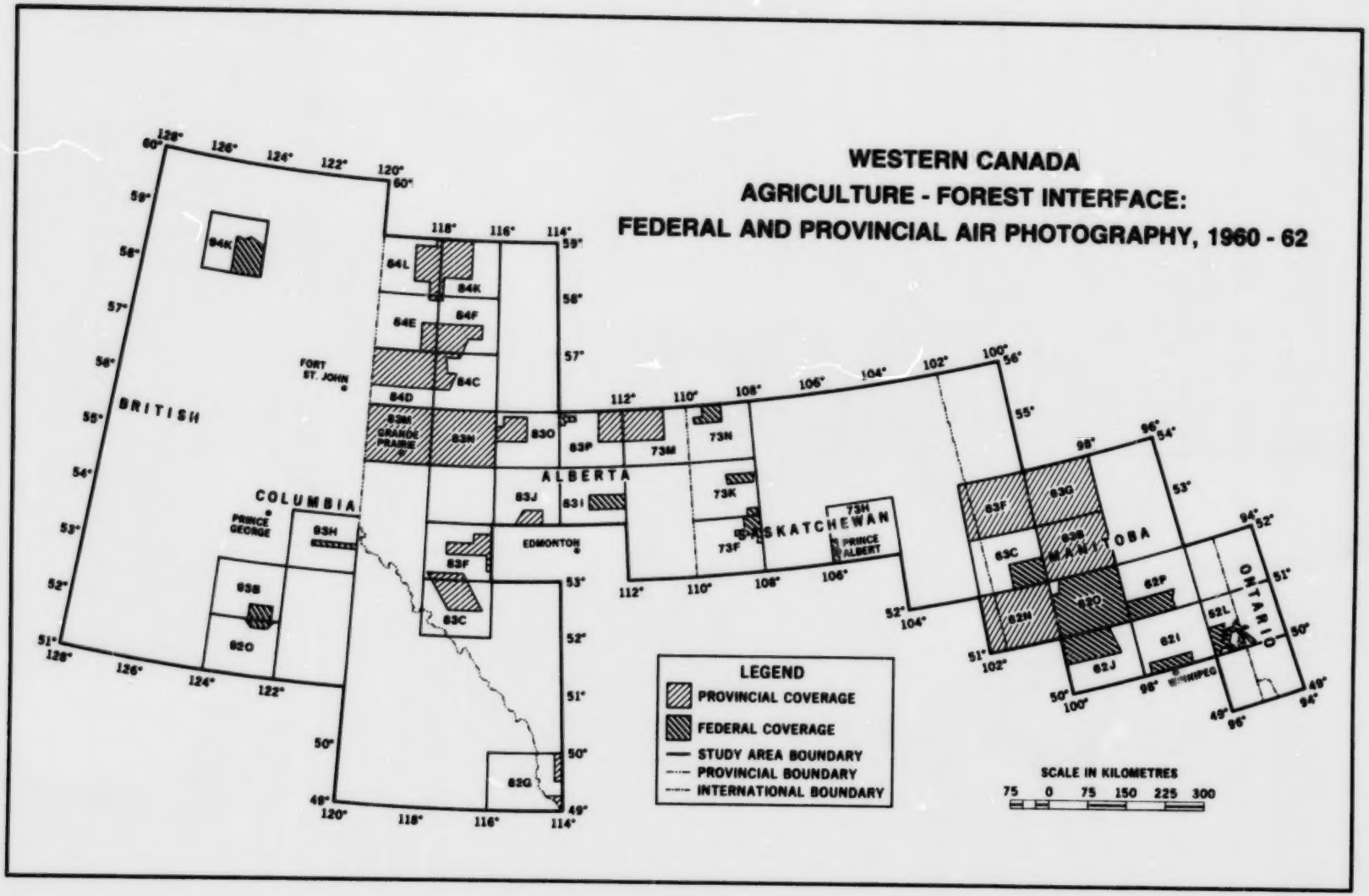
WESTERN CANADA
AGRICULTURE - FOREST INTERFACE:
FEDERAL AND PROVINCIAL AIR PHOTOGRAPHY, 1960 - 62
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
FORT ST. JOHN
GRANDE PRAIRIE
PRINCE GEORGE
EDMONTON
PRINCE ALBERT
WINNIPEG
LEGEND
PROVINCIAL COVERAGE
FEDERAL COVERAGE
STUDY AREA BOUNDARY
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY
SCALE IN KILOMETRES
75 0 75 150 225 300

FIGURE 9

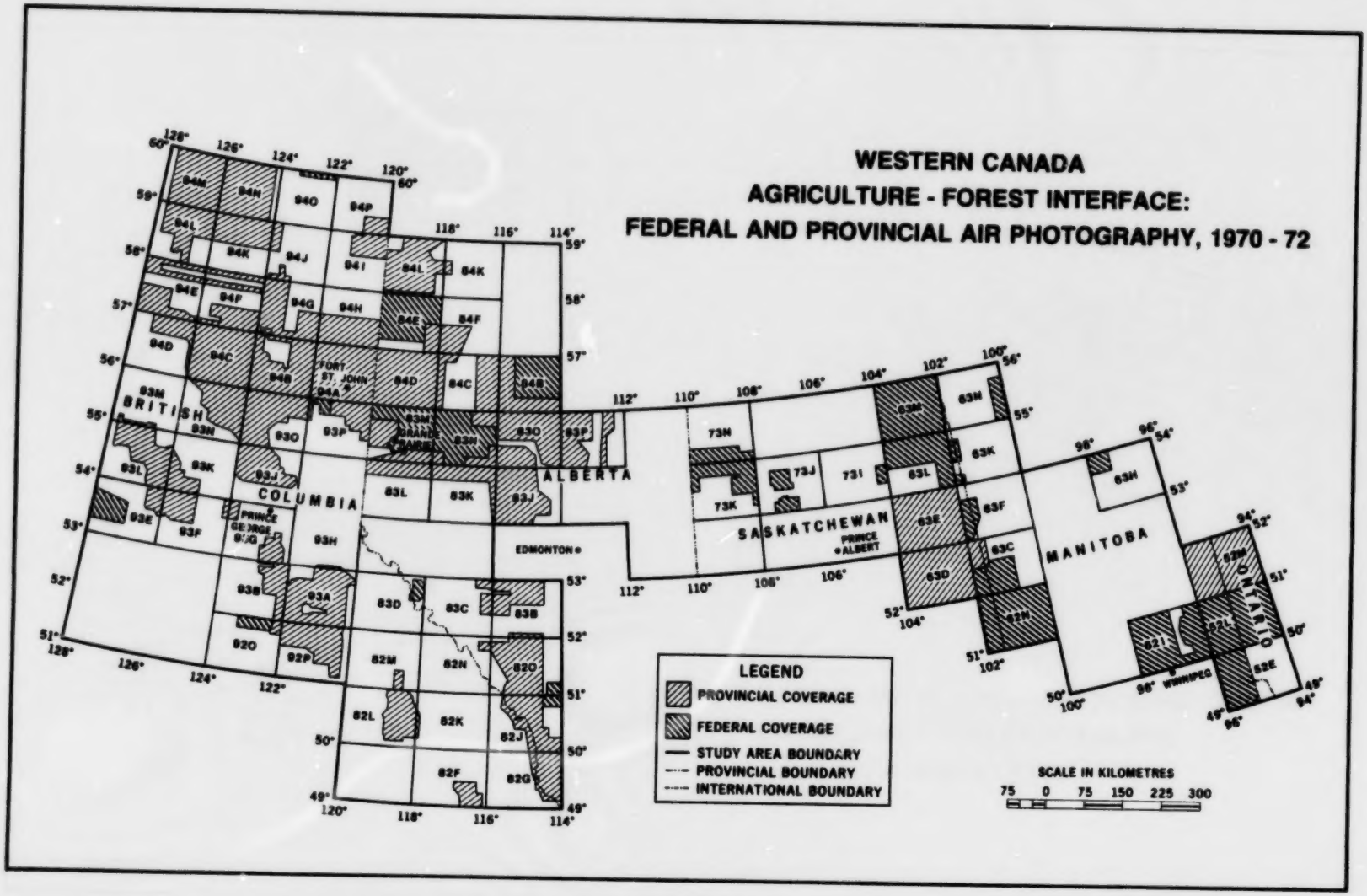
WESTERN CANADA
AGRICULTURE - FOREST INTERFACE:
FEDERAL AND PROVINCIAL AIR PHOTOGRAPHY, 1970 - 72
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
FORT ST. JOHN
PRINCE GEORGE
EDMONTON
PRINCE ALBERT
WINNIPEG
LEGEND
PROVINCIAL COVERAGE
FEDERAL COVERAGE
STUDY AREA BOUNDARY
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY
SCALE IN KILOMETRES
75 0 75 150 225 300

FIGURE 10

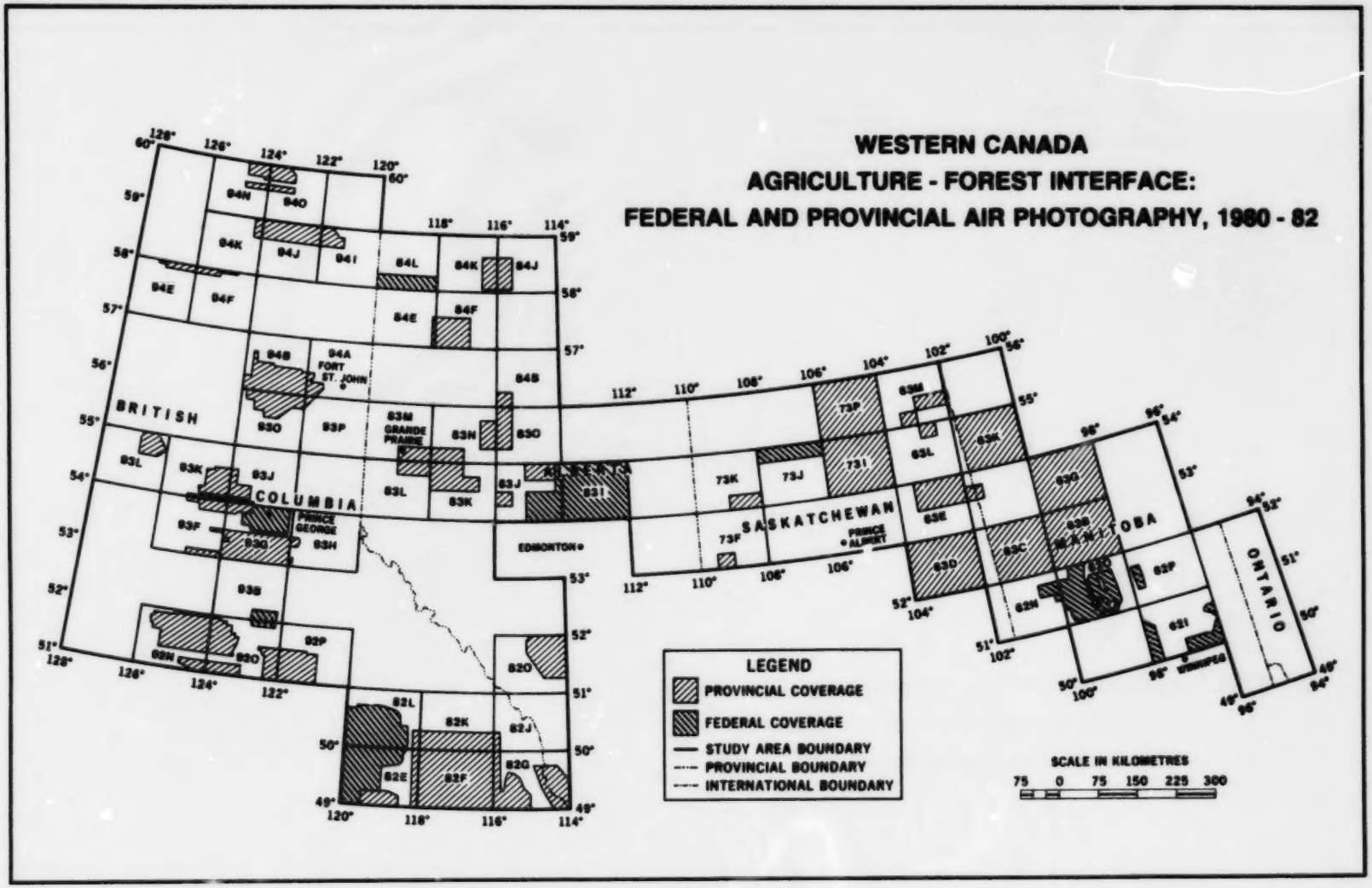
WESTERN CANADA
AGRICULTURE - FOREST INTERFACE:
FEDERAL AND PROVINCIAL AIR PHOTOGRAPHY, 1980 - 82
BRITISH COLUMBIA
SASKATCHEWAN
MANITOBA
ONTARIO
EDMONTON
PRINCE GEORGE
PRINCE ALBERT
WINNIPEG
FORT ST. JOHN
GRANDE PRAIRIE
LEGEND
PROVINCIAL COVERAGE
FEDERAL COVERAGE
STUDY AREA BOUNDARY
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY
SCALE IN KILOMETRES
75 0 75 150 225 300

FIGURE 11

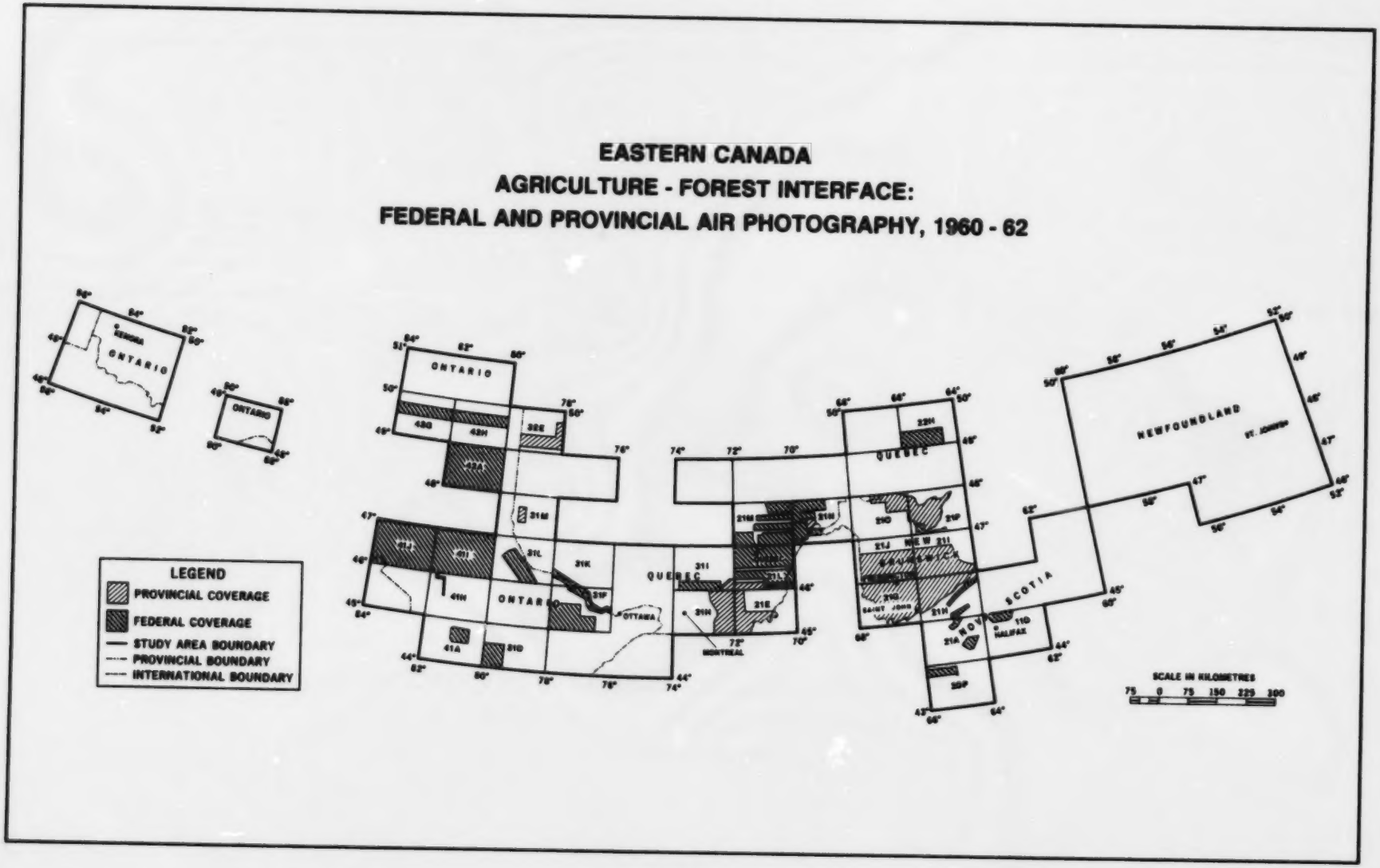
EASTERN CANADA
AGRICULTURE - FOREST INTERFACE:
FEDERAL AND PROVINCIAL AIR PHOTOGRAPHY, 1960 - 62
ONTARIO
ONTARIO
QUEBEC
NEWFOUNDLAND
ST. JOHN'S
SCOTIA
NOVA
HALIFAX
OTTAWA
MONTREAL
LEGEND
PROVINCIAL COVERAGE
FEDERAL COVERAGE
STUDY AREA BOUNDARY
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY
SCALE IN KILOMETRES
75 0 75 150 225 300

FIGURE 12

# EASTERN CANADA
# AGRICULTURE - FOREST INTERFACE:
# FEDERAL AND PROVINCIAL AIR PHOTOGRAPHY, 1970 - 72

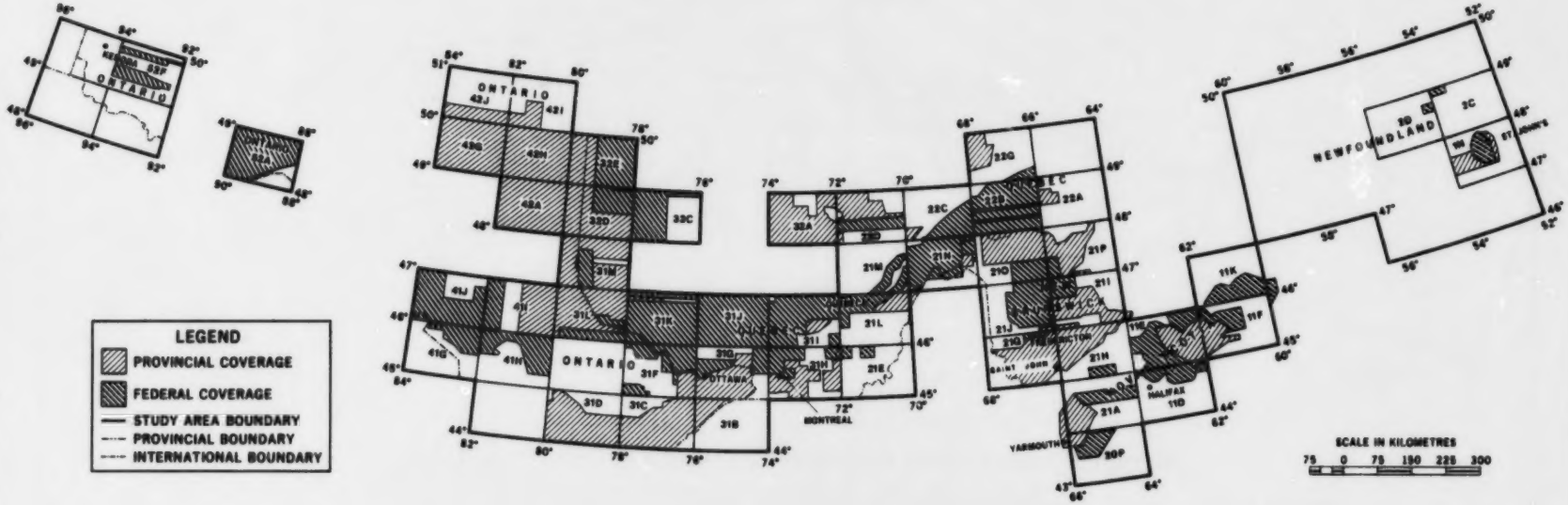


FIGURE 13

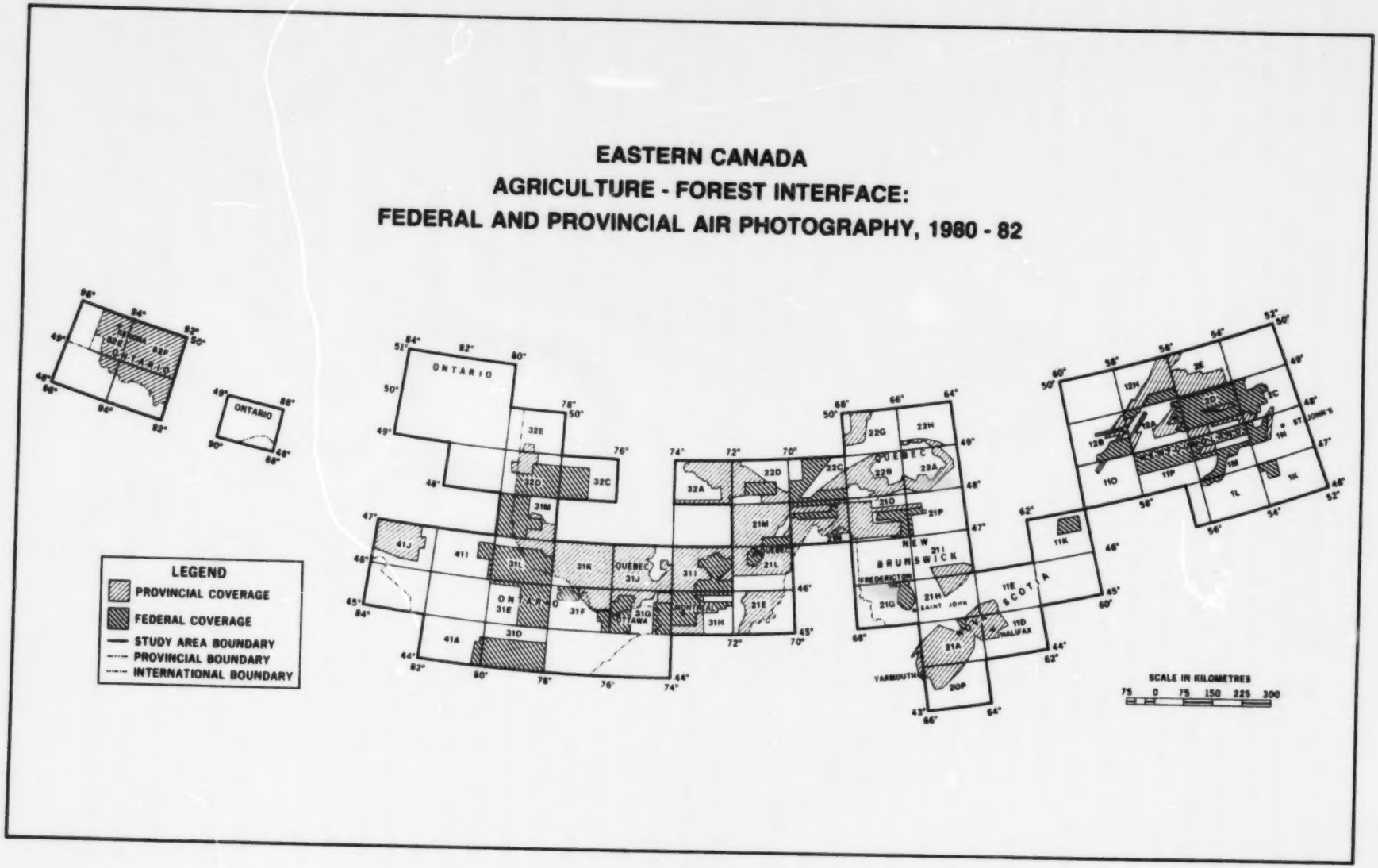
EASTERN CANADA
AGRICULTURE - FOREST INTERFACE:
FEDERAL AND PROVINCIAL AIR PHOTOGRAPHY, 1980 - 82
ONTARIO
LEGEND
PROVINCIAL COVERAGE
FEDERAL COVERAGE
STUDY AREA BOUNDARY
PROVINCIAL BOUNDARY
INTERNATIONAL BOUNDARY
QUEBEC
NEW BRUNSWICK
NOVA SCOTIA
NEWFOUNDLAND
SCALE IN KILOMETRES
75 0 75 150 225 300

FIGURE 14

period. It should be noted that provincial government photography for Saskatchewan for the years prior to 1972 are maintained by the National Air Photo Library and are referenced in the federal indexes for these years. Information received regarding photography available from provincial sources in Manitoba was summarized in written form with limited reference to the National Topographic System (NTS) map sheet numbers. As a result, the coverage available for certain areas of the province may be less complete than indicated in this overview. A number of the responses received from private firms noted that most of the coverage flown was for either various levels of government or private firms who subsequently retain the rights to the film.

Overall, the most complete coverage of the general agriculture-forest interface zone exists for the years 1970-1972, followed by the 1980-1982 period (Table 2). In both cases, however, coverage is available for an average of less than half the agricultural-forest zone noted in Figure 1. The smallest amount of photography is available for the 1960-1962 time period when less than 25 percent of the same area was covered. The portion of the study area for which aerial photography was flown during all three time periods is small (less than 11 percent) compared to that covered during any single period.

Areas covered by air photos at all three time periods are small and scattered (Table 3a) and there is no coverage whatever in Newfoundland and Saskatchewan; coverage in British Columbia is insignificant. One of the most extensive coverage areas is from Grande Prairie to High Prairie in the Peace River region. Other areas of potential interest in this study include The Pas (Manitoba) and Sudbury (Ontario) and parts of Nova Scotia and New Brunswick, all of which show some characteristics of the agriculture-forest interface, although none were identified as major subareas.

Air photo coverage is much improved, however, if only two time periods are considered, rather than all three. Much larger areas of most provinces have coverage for both the 1970-1972 and 1980-1982 periods (Table 3c). Coverage is especially improved for British Columbia, Saskatchewan, Nova Scotia, Quebec and Ontario. However, 1960-1962 and 1980-1982 periods provide better coverage for Manitoba and marginally for New Brunswick (Table 3b). In general, parts of many of the agriculture-forest subareas identified in Chapter Two have some sequential air photo coverage: Prince George and the Kootenays in British Columbia, the Peace River Valley and the Eastern Slopes in Alberta, the Carrot River Lowland in Saskatchewan, the Interlake, Winnipeg River and The Pas in Manitoba, the Southern Shield of Ontario, the Eastern Townships, Lower St. Lawrence and the Matapédia in Quebec and various locations in the Maritime Provinces. A notable gap in sequential coverage is for the Clay Belt in Ontario.

The gaps in air photo coverage of agriculture-forest interface areas for the three designated time periods are such that air photos could not provide the data for a comprehensive survey of land use change in all study sub-areas across the country. In any event, the sheer number of photographs to be handled and interpreted would

represent a major constraint: at an intermediate scale of 1:30,000, the land capable of supporting agriculture in the Ontario Clay Belt, an area of about 2 million hectares, would require over 1600 photographs for one time period alone, if stereocoverage were to be obtained. However, study of changes between 1960-1982 or 1970-1982 over more restricted areas of the agriculture-forest interface would be feasible using medium scale air photos.

The need to monitor extensive areas prompts consideration of satellite imagery, capable of providing the synoptic view, as a source of information. LANDSAT multispectral scanner data has been used to map different types of land cover (Reeves, 1975) and for change detection (Eyton, 1983). Unfortunately such data have only been obtainable on a regular basis since 1972. The satellite passes over all areas of the country every 18 days. Data are routinely recorded on high density tapes and imaged on fiche, from which checks can be made for image quality and cloud cover. Data can be obtained in a variety of forms including transparencies and paper prints (both single band and colour composite) as well as computer compatible tapes. As LANDSAT data are available for all seasons, consideration must be given to the question of which season would be most appropriate for monitoring land use change at the agriculture-forest interface. The optimal season for monitoring changes may vary with the type of land conversion. For example, forest land clearing can be readily detected on sequential winter images because of a high contrast between snow cover of the cleared areas and trees in the uncleared areas (A. Turner, pers. comm., 1984). On the other hand, winter images are unlikely to be of value in the detection of more subtle land cover changes such as conversion from one type of crop to another.

Aerial photographic coverage is such that it could not be used to map past land use changes over extensive areas of the agriculture-forest interface, although it could be used for small selected areas. However, general changes on land cover over broad areas might be monitored, for 1972 onwards, by means of LANDSAT imagery, with aerial photographs, where available, providing checks on interpretation.

### 3.2 Land Use Change and Land Resource Data Bases and Maps

A wide variety of land resource data bases and map series, of potential value in the study of the agriculture-forest interface, has been compiled by the federal and provincial governments. A listing of each source, with an accompanying description, appears in Appendix 3.

Unfortunately, comprehensive data bases of land use change, with a broad array of land use categories, are uncommon. Instead, data sources tend either to be focussed on one resource use, such as forestry or agriculture, or to monitor tenure or ownership patterns, as in the case of Crown land inventories. Such data sources are useful in assessing land use change in restricted areas but they are limited by inconsistencies in scale and coverage.

Each province maintains map-based forest inventories, recording both vegetation cover and major land base divisions such as water, non-forested land, non-productive forested land, productive forested land and so on. The updating of forest inventory data varies from annual to irregular intervals. It has been suggested that current and previous inventories may be used to identify land parcels passing into and out of forest use through time (Bunce, 1983).

In order to provide improved forest resource data at the national level, the Forestry Statistics and Systems Branch (FSSB) of the Canadian Forestry Services has implemented a computer-based system to produce both forest inventory and change data at the national and provincial level (Bonnor, 1982; 1983).

Through this Canadian Forest Resource Data Program forest inventory data for Canada's forest lands are assembled from federal and provincial sources for 40,000 summary cells with an average area of over 100 km². The inventory data, in redefined form to fit a national classification system, are stored in computer files from which tabular summaries and data for mapping can be generated. Forest inventory choropleth maps can be produced on a computer-controlled plotter.

In response to the increasing need for data on the land dynamics of forest growth and depletions, the FSSB has initiated a program to monitor change (Forestry Statistics). The purpose is to provide a basis for assessment of changes at the district, provincial and national levels. Under the program the following variables will be reported to the nearest hectare: harvest cuttings, silviculture measures, fire, insect, disease and weather damage and withdrawals of land from, and additions to, non-reserved forest-land use. As the data utilised will be collected from the provincial governments, the establishment of change data bases for forest resources at the provincial level will be required.

The province of Manitoba presently has a data bank on forest change, including harvest cuttings, silviculture measures and fire damage, with a capability of recording both additions and withdrawals, although the two latter have not yet been included in the system (M. Powers, pers. comm., 1984). A pilot project involving cooperation between the Forestry Statistics and Systems Branch and the government of Manitoba has shown the monitoring of forest change to be feasible (Environment Canada, Canadian Forestry Service, 1984). The British Columbia Forest Inventory includes some land status information and the Inventory Branch of the Ministry of Forests monitors some land use changes. It is not known whether or not other provinces have been collecting data on land use change (Bunce, 1983).

The FSSB intends to update the forestry change data annually, although published reports will be released every three to five years. The completion of the first compilation of change data has been tentatively scheduled for the fall of 1985 and it is anticipated that the first published report will be released in the 1985-1986 fiscal year (M. Powers, pers. comm., 1983).

It should be noted, however, that land use change data are only a relatively small and incomplete component of the Canadian Forest Resource Data Program. A sector view of land use change is taken, recording changes to and from forestry alone, rather than considering changes to and from other categories of land use. Thus the data base is of limited value to a study of land use dynamics in the agriculture-forest interface.

Data on agriculture have generally been gathered on a more systematic and long term basis than forest data. The Agricultural Census of Canada is conducted by Statistics Canada every five years and provides information on agricultural activities and land use at the enumeration area level. Unfortunately changes in definitions and boundaries of census divisions and subdivisions from one census to the next mean that land use changes cannot easily be monitored from published census volumes. However a national data set has been derived from census returns for six core variables and approximately 200 derived variables in 229 districts with constant boundaries (McCuaig and Manning, 1982). The data, available for five year intervals from 1961 to 1981, are stored on the Lands Directorate's DEC PRO350 microcomputer. Having been aggregated for a variety of areal units, census data provide valuable measures of net land use change, but no opportunity for assessment of the dynamics of land use change.

Land use maps prepared in the 1960s for the Canada Land Inventory (CLI) under the ARDA Program potentially provide baseline information on agricultural land use that, in conjunction with another data source, might be used to investigate land use change dynamics in the agriculture-forest interface. The Canadian Land Inventory covered the country's agricultural ecumene and adjacent areas (Canada Land Inventory, 1978), thus including agriculture-forest interface sub-areas. CLI land use maps were based on the most recent aerial photography (circa. 1967). Aerial photos of different dates and scales were employed to compile the 1:50,000 Field maps; more field checking was undertaken if the photography was dated (McClellan et al., 1968). CLI land use is stored at the 1:250,000 scale on computer as part of the Canada Land Data System, Lands Directorate.

Ten broad land use categories are used on CLI maps: urban; horticulture, poultry and fur operations; orchards and vineyards; cropland; improved pasture and forage crops; rough grazing and rangeland; woodland (productive and unproductive); swamp, marsh or bog; unproductive land; and water. The rough grazing and rangeland class is subdivided into a natural grassland/abandoned farmland category and a woodland grazing category.

Also of use is the CLI land capability map series. The land resource in Canada's agricultural ecumene was rated for capability for serveral uses, regardless of present use, other use capabilities or economic factors. The inventory mapped the southern settled portions of Canada, and provided separate map series for soil capability for agriculture, land capability for forestry, land capability for recreation and land capability for wildlife - ungulates and waterfowl. Mapping was

undertaken in the 1960s and early 1970s at a scale of 1:50,000 involving both field work and extrapolation from existing resource data.

Each of the CLI capability ratings extend from class I, the "best" land for a particular use, downwards through classes of lower capability to class 7 with negligible capability for a particular land use. The agricultural capability inventory rates the land for cereal crop production. In the case of forestry, classes are rated for production of indigenous tree species at full stocking under good management. Except for recreation, CLI capability ratings are based on the concept of limiting factors; the number and severity of limiting factors cumulatively downgrading the land capability. For recreation, the land is evaluated on the basis of opportunities and carrying capacity.

Generalized CLI land capability data are published at the 1:250,000 and the 1:1,000,000 scales. The CLI capability information for all sectors, as well as the land use data, are stored at the 1:250,000 scale on computer as part of the Canada Land Data System (CLDS), Lands Directorate. The CLDS system has the capability of analysing overlays of land capability, land use and other spatial data for selected study area ranging in size from regions to national coverage. Data bases on land capability and use can be created on CLDS at the 1:50,000 scale for local studies. For further information on the CLI, particularly the agricultural and forestry inventories, see symington, 1968, and Canada Land Inventory, 1972A, 1972B and 1978.

With CLI maps or the CLI information on the Canada Land Data System, comparison of land use to land capability for various sectors or analysis of the capability of a land parcel for different uses - agriculture, forestry, wildlife - is possible for areas along the agriculture-forest interface. The CLI inventory permits researchers to determine the "best" use, from the standpoint of capability, for lands subject to conflicting pressure for use or conversely, left idle or underutilized.

Several provincial governments have developed agricultural data bases for at least part of the area under their jurisdiction. Alberta Agriculture developed a computerised inventory of agricultural land use changes between 1976 and 1980. Variables in the data base include the amount, location and quality - assessed by Canada Land Inventory classification - of land converted to or from agriculture. The uses to which land removed from agriculture was put are categorised and tabulated: subdivision of agricultural land for non-agricultural use; urban annexations; rural road construction; and resource extraction including oil and gas wells, gas plants and surface coal mines. Land conversion trends and geographical patterns have been identified and correlated with land productivity classes. An update of the 1976 to 1981 study was released in 1983 (Alberta Agriculture, 1983b). It is not intended to continue to monitor changes to the agricultural land base on a regular basis; ongoing changes do not appear as major as those that occurred in the past ten years,

although a further inventory publication may be released in two or three years (K. McDonald, pers. comm., 1984).

Alberta Agriculture also maintains a computerised data base of all legal land title changes in rural areas. Available information includes: legal description, assurance fund value, certificate of title number, predominant CLI classification for the quarter section, registration date and ownership status.

The government of Ontario has developed several sources of data which are of potential interest in the study of the agriculture-forest interface. From 1978 to 1980 the Ontario Ministries of Natural Resources and Agriculture and Food jointly undertook a forestry-agricultural resource inventory of the six eastern counties of Grenville, Dundas, Stormont, Russell, Glengarry and Prescott. The purpose of the inventory was to provide a basis for recommendations designed to optimise agricultural and forestry production in Eastern Ontario. However, no updating of this inventory for monitoring purposes has yet been scheduled (D. Dunn, pers. comm., 1983).

Ontario's Agricultural Resource Inventory, undertaken in 1982 and 1983, is based on the method used to inventory Eastern Ontario. (Ontario Ministry of Agriculture and Food, 1983). Over 1000 maps have been prepared to portray information on agricultural land use and drainage. Land use is mapped on the basis of farming systems or crop rotations and combinations. Although the map systems are valid over a long period of time (e.g. 5 years or more), experimental work at updating the maps and measuring change in the Farming systems is being undertaken by the Province (G. Jackson, 1984).

The Ontario Centre for Remote Sensing has proposed a series of colour land cover maps based on digital processing of satellite (LANDSAT) imagery (V. Zsilinszky, pers. comm., 1983). The entire province can be covered at a variety of scales, as required: 1:250,000, 1:100,000, 1:50,000. The proposal is presently being evaluated. Should the series be repeated, it would provide the basis for monitoring land cover changes in the agriculture-forest interface areas of the Ontario Clay Belt.

The Quebec Commission de Protection du Territoire Agricole has been mapping, since 1980, extent of ownership in the approved agricultural zones in each Quebec municipality on a cadastral map at a scale of 1:20,000. The Commission is considering mapping land use change over the period 1979 to 1984 or 1980 to 1985 on the basis of aerial photographs. The evolution of land in both agricultural and non-agricultural zones would be monitored.

In the Maritime Provinces there are two data sources of potential interest, covering relatively restricted geographic areas. In 1982, the Maritime Resource Management Service conducted a land use survey of Kent County, New Brunswick, to study changes (1963 to 1982) affecting land that was cleared as of 1963 (Mandale, 1984). The data were digitised at a scale of 1:10,000, with computer-assisted maps generated at a 1:100,000 scale and reproduced in Mandale (1984).

Between 1979 and 1981 the Nova Scotia Department of Municipal Affairs conducted a survey of cleared land in Nova Scotia's prime agricultural areas. Parcels of land were classified according to intensity of agricultural use and the stage of reversion, if any, of agricultural land to woodland cover. Information was collected in the field on 1:10,000 orthophoto maps and drafted for municipal planning purposes at the same scale.

Land use and land use change data bases developed by federal and provincial governments tend to be either geographically comprehensive but single sector oriented, or geographically restricted but with information on a number of land uses. At the national scale agricultural and forestry data bases may be adequate for a reconnaissance survey of the agriculture-forest interface although, as in any case when several data sources are used, the variety of scales and mapping units used pose a potential problem. Nevertheless, the feasibility of combining agricultural census statistics with national forestry data from the Canadian Forest Resource Data Program might be explored. There is, however, a lack of information on land uses other than forest and agriculture. It may be impractical to supplement data at the national level with information collected for local or regional studies, partly because of the sporadic nature of such information and partly because widely varying criteria, classification systems and scales have been applied in the collection of land use data in different studies. In many cases, too, the objective of data collection has been to provide an inventory of resources or land use types at one point in time rather than to perform ongoing monitoring.

Existing data banks for regional and local studies of land use change in the agriculture-forest interface appear to be most adequate for the Peace River Region of Alberta. The Ontario government proposal to produce land cover maps from satellite imagery, is perhaps pointing the way to future methods of monitoring change, although it is of little value for detecting changes prior to the early 1970s.

### 3.3 Research and Planning Studies and Activities

A wide diversity of research and planning activities related to land use change at the agriculture-forest interface was identified from questionnaire responses and bibliographic research. A listing of the most pertinent works identified during the course of this study is contained in Appendix 4. There is necessarily some overlap between the sources discussed here and those cited in the preceding sections on issues and land resource data bases. Few of the studies focus exclusively on land use change and the objectives of most studies are somewhat tangential to present objectives.

To date, study of land use change between areas of primarily agricultural use and regions of predominantly woodland and forest has not been undertaken on a national scale in Canada. The Lands Directorate, Environment Canada, although, is currently undertaking analyses of the extent of abandoned agricultural lands on the margins and the socioeconomic causes of

these trends in case studies of eastern New Brunswick, Kent County, the Gaspé Peninsula and Renfrew County, Ontario - see Appendix 4. In general, however, the research and planning activities identified focus primarily on land use change and issues at the provincial and local levels. The activities examined in the studies vary in nature and scale and in the degree to which they relate to or influence land use change at the agriculture-forest interface. The range of activities reflects both the number and jurisdiction of agencies responsible for, or with interests in, agriculture, forestry, resource management and land planning. Activities range in scale from province-wide, integrated resource management strategies involving both multiple government and non-government agencies to local Crown land plans.

Many sub-areas of the agriculture-forest interface have been the subject of research and planning studies. Such activity appears to have been most intensive in the western half of the country, probably a result of the more acute competition for land for various uses than has existed in the east. However, a higher questionnaire response rate from western Canada might account in part for a more comprehensive list of planning and research than obtained for eastern Canada. The Peace River region, one of the most actively advancing agricultural frontier areas in the country, has received particular attention for both data collection and the formulation of planning and resource development strategies. Some of the eastern sub-areas, such as those in the Eastern Townships of Quebec, have apparently attracted relatively little research attention so far.

In most recent plans and planning studies recognition is given to the interaction and conflict between resource users at a regional scale of analysis. Examples of such plans include the Deferred Planning Areas of British Columbia, the Integrated Resource Management Plans of Alberta, the Crown Land Classification Plans in Manitoba, the Strategic Land Use Plans of Ontario and the Crown Land Plans of Newfoundland. While the area covered by these plans varies considerably in size, each of these strategies attempts to resolve land allocation problems involving such uses as forest, agriculture, recreation and wildlife. Even in single sector analyses, like British Columbia's Forest and Range Resource Analysis, recognition is given to what are termed "resource interactions" - the effects of one resource use, such as timber, on others such as range land, recreation and power development.

All provinces are committed to some form of integrated planning strategy, ranging from Ontario's comprehensive integrated Strategic Land Use Plans to Newfoundland's more specific Crown land plans. The fact that both strategic and local area plans for parts of the agriculture-forest interface have been, or are being, developed, highlights the growing concern for land allocation in a zone where agriculture and forest uses compete for land of suitable capability.

Although numerous land use plans have been formulated, there has been little research into land use dynamics in the agriculture-forest interface. The basis of understanding such dynamics would be provided by monitoring

land use conversion over the last fifteen or twenty years for a variety of study areas and at local or regional scales.

Information about land use and land use change at the agriculture-forest interface is available from a wide range of sources, a few of which, such as the Census of Agriculture, Canada Land Inventory, national forestry data and satellite imagery, provide relatively comprehensive coverage. However, most data sources relate to areas ranging in extent from whole provinces to local regions, with the attendant difficulty of comparability of information. Areas for which most data are generally available are those experiencing land use competition in western Canada, especially the Peace River region.

## 4.0 STRATEGIES FOR FURTHER STUDY

The agriculture-forest interface possesses national, regional and local dimensions. As a national phenomenon, the main characteristic of the interface is one of substantial land use change between agricultural and forest land classes. The prime concern at this scale is to ensure that the forest and agricultural land bases will be sufficient to supply future needs. Regionally, the main distinction is between interface sub-areas on the advancing agricultural frontier in the west and those on the retreating agricultural margin in the east. At the local scale, land pressures at the interface commonly involve a variety of land uses. Ideally, all scales of analysis should be addressed in the future study of land use change on the agriculture-forest interface in order to serve a variety of purposes and different government levels and interest groups.

Two general strategies for further study are proposed: a national overview and a case study approach. Individually, each method is suited to a particular scale of analysis. Used in combination, however, they potentially provide more insight than the sum of the results of the individual approaches.

### 4.1 National Overview Approach

Clearly, detailed monitoring of land use changes in Canada's agriculture-forest interface on a nationwide basis would require an enormous research effort. However, reconnaissance level research, drawing upon federal agricultural census and forest inventory statistics, C.L.I. land use and land capability data (circa 1966) and satellite imagery, would be feasible. A determination of the amount of land shifting from one category to another, especially between the forest and agriculture classes, is needed in order to be able to address the concern regarding sufficiency of the forest and agricultural land bases to meet future needs. A national balance sheet of gains and losses in each category, together with an assessment of uncommitted resources, is required to permit rational decisions regarding land allocation to be made. In order to provide an historical context for contemporary land use changes it is recommended that such monitoring be undertaken from at least as early as 1971 to the present.

A potential difficulty in developing a reconnaissance level monitoring scheme for the general agriculture-forest interface zone concerns the availability and quality of the necessary data. While data collected through federal government programs, such as the Census of Agriculture and the Canada Land Inventory, are comparable from one part of the country to another, information gathered by agencies and departments of different provincial governments are not always directly comparable or complete in coverage. Thus, prior to launching such a program, investigation of the comparability of data, more detailed than was possible in Chapter Three, is required to determine whether or not differences between data sets might be reconciled. The potential of combining selected variables from the Canadian Forest Resource Data System of the Canadian Forestry Service with selected variables from the Census of Agriculture to form a

agriculture-forest data base for interface areas should also be examined. Based on these data sets, however, only net land use change rather than dynamic land use change can be obtained, probably at the census division level. A study into the feasibility of combining the agricultural census and forest inventory data sets is continuing at the Lands Directorate under the Rural Land Analysis Program.

The research effort required for a national overview approach could be much reduced by implementing a sampling procedure. Following the recommendations of Bryant and Russwurm (1983), a multistage sampling design within a system of stratification is suggested. Forest and farmland should form the two main strata, which should be defined in terms of census divisions to enable the wealth of data recorded for those divisions to be linked to the study where appropriate. Clusters or cells should have a minimum size of 3.25 sq. km and a ten year cycle to coincide with census data as appropriate (Bryant and Russwurm, 1983, 66). In areas of particularly high rates of change a five year interval should be considered.

The chief drawback of using a sample rather than a complete inventory for assessing land use change between forest and agriculture is the reliability of the estimates of land use change obtained. The area of land changing use is relatively small compared with the total land under study and the spatial distribution of land changing uses tends to be quite highly localised. This situation has obvious implications for the fineness of the sampling network. Investigation into the effect of the density of the sampling clusters on reliability of results under circumstances of small, localised land use changes is recommended.

A disadvantage in using solely an approach based on a national overview is that less important land use trends and conflicts, although still potentially very significant at more detailed levels of analysis, might be overlooked. Thus case studies are proposed to provide insight into more detailed trends at the regional level and into the factors and processes underlying land allocation and management decisions by individual and institutional landowners.

### 4.2 Case Study Approach

National land use trends are the result of a myriad of decisions taken at the local level regarding the use of individual parcels of land. Therefore detailed case studies have the potential not only for highlighting regionally significant trends but also for providing an understanding of the processes that generate patterns at the national level.

The case study approach involves four research components (McCuaig and Manning, 1982; Mandale, 1984):

1) a survey of land use
2) analysis of socioeconomic data from census and provincial and local sources
3) questionnaire/interview survey of landowners and
4) interviews with provincial and local resource specialists.

A detailed investigation of contemporary land use change is proposed for selected

sub-areas of the agriculture-forest interface. Reasonably reliable estimates of the amount of land changing from one use, or cover, category to another are required. A more comprehensive list of land use or cover categories is required than in the national overview, which focusses specifically on agricultural and forested land. Spatial changes in activities and uses such as various forms of recreation, wildlife management and conservation, watershed protection, fishing, energy extraction, residential development as well as forestry and agriculture should be monitored. Basic land cover maps for selected areas could be obtained from a combination of existing maps, aerial photographs and Landsat imagery. The uses that occur in, or are assigned to, a particular cover class cannot always be inferred from such imagery. Under these circumstances, therefore, information regarding designated use of land would have to be obtained from land use plans and other land use data bases. It is important to establish baseline data at some past time as well as develop a current inventory so that an indication of present trends can be obtained from an analysis of recent changes.

Ideally, baseline data might be assembled for 1961, with updated information for 1971 and 1981. Aerial photographic coverage for 1961 is the sparsest of all the years (see Chapter Three), but C.L.I. land use information is usually available for the 1960s. Given its high degree of spatial coverage it could form the basis for baseline data. Should any small gaps in coverage exist, aerial photographs might provide the necessary information. Thus it would seem appropriate to establish baseline data for circa 1966, together with an inventory for 1981. Should trends need to be verified, selected data for 1976-1977 might be used.

Following the land use survey, analysis of socioeconomic data from census, provincial and local sources should be undertaken to provide a factual background to the study areas, focussing particularly on historical trends. Data from the 1951, 1961, 1971 and 1981 censuses should be examined at various levels of aggregation including the whole case study area, census divisions and, where data availability permits, census subdivisions.

In order to investigate the perceptions, decisions and intentions of those individuals capable of influencing land use, a survey of landowners by questionnaire or interview is recommended. A sample of landowners should be selected to ensure representation of both the variety of land uses in the study area and areas of particularly high rates of land use change.

The final phase of the case study approach involves a series of interviews with provincial and local personnel engaged in land resource management, research and planning. Views on land use issues and information on land use trends and provincial and local government policies and initiatives should be obtained.

The case study approach requires several sub-areas from those discussed in Chapter Two to be selected for further study. Criteria applied in this selection process should include representation of: the main

regions of the country; types of land use change such as agricultural expansion and farmland abandonment; different land use issues; and varying levels of local and provincial government initiatives.

Based on the above criteria, a tentative list of case study areas includes: the Prince George region of British Columbia; the Peace River region of Alberta and British Columbia; the Interlake area of Manitoba; the Clay Belt of Ontario; and Beauce in the province of Quebec. On the basis of regional representation one area in the Maritime Provinces should be included, although there is currently insufficient evidence to support the inclusion of one region over another.

Those sub-areas of the agriculture-forest boundary zone experiencing substantial land use changes were identified in Chapter Two. Not all parts of each sub-area, however, have been subject to substantial land use change. Thus, while it is appropriate to review trends throughout the whole case study area, particular attention should be focussed on those districts with high rates of change. Intensive study, therefore, should be preceded by a reconnaissance level survey - more detailed than that undertaken at the national level - to permit identification of districts of high rates of change and significant land use issues occurring within the sub-area. Such reconnaissance might be undertaken using Landsat images to detect changes in land cover, together with a questionnaire, more specific than the one used in the current study, administered to planners and land resource specialists working on the geographic areas of interest.

The national overview and case study approaches are viewed as complementary. The former has the potential of providing insights into issues of national concern as well as allowing the case study areas to be viewed in the national setting. However, national trends are the result of many decisions taken at the local level by individual landowners, resource specialists and planners for a variety of reasons, be it responding to an economic opportunity or to a government regulation. Therefore, detailed analyses of land use change identified in the case studies will provide the potential both for verification of national trends and for gaining an understanding of the complexity of land pressures underlying those trends.

## 5.0 SUMMARY AND CONCLUSIONS

### 5.1 Land Use Issues on the Agriculture-Forest Interface

The competition between agricultural and forest uses for land bases of suitable capability has been identified as the central land issue associated with the agriculture-forest interface nationwide. At the agricultural margin in the west, farming and forestry commonly compete for the same land; marginal farming often expands on to land with a relatively high capability for forests, while land previously cleared for farming might be either underutilized or even abandoned. In the west, therefore, the land allocation and management process ought to ensure that land conflicts are resolved in such a way that land uses are appropriate to the resource potential of the land. In the east, substantial areas have been taken out of agricultural production, creating potentially large reserves of either farmland, albeit relatively marginal, or forest land, although these lands are often held under fragmented ownership. The area of land that will actually be needed to satisfy future needs in both sectors depends on several variables, future trends of which are difficult to predict: market conditions, land competition and technology. The land planning process ought to consider the allocation of currently underutilized land to forests, pastures, wildlife preserves and so forth; or in the short term at least, its retention in an idle state that would not preclude its future allocation for alternative uses including agriculture, forestry, and other renewable resource uses.

Land issues at the regional and local levels are often complex, with competition occurring between a wide variety of activities including, in addition to farming and forestry: energy development, wildlife conservation, recreation, residential development, trapping and fishing. There have been local land use conflicts in eastern parts of the country, where land abandonment has occurred. For example cottaging has been cited as interfering with both forestry and wildlife interests. A common response to competition for land has been the promotion of multiple use especially in forested areas. The prime argument in favour of multiple use is that aggregate benefits are potentially greater than under single use. But aggregate benefits and the group to which those benefits will accrue are difficult to define. In addition, each activity on forested land has some negative effects on other activities (Environment Council of Alberta, 1979, 85).

A multiplicity of government departments and regional governments is usually involved in land resource planning, some representing competing interests. The fact that jurisdiction is divided among government levels and agencies poses a challenge to the coordination, development and implementation of land allocation and management strategies on the agriculture-forest interface. Such fragmentation of responsibility among government levels can impede the introduction of plans, incentives and regulations that would reduce conflicts or allow new initiatives to be undertaken. Competition between agriculture and forests could be reduced, for instance, by reclaiming abandoned agricultural land as opposed to clearing new land for agriculture. But stronger policies

as well as a clarification of roles and responsibilities between levels of government may be necessary to promote such a trend.

## 5.2 Important Geographic Areas on the Agriculture-Forest Interface

Areas of substantial land use change have been identified in the agriculture-forest interface in most provinces. Many of the valley floors in British Columbia exhibit some characteristics associated with the interface: some of the better forest lands in the valleys have been cleared for a variety of uses including agriculture, recreation and residential development. The Peace River region of British Columbia and Alberta is the most extensive sub-area where marginal farmland continues to be opened up at the expense of forest and bush land. Increasing pressure from agriculture, residential and recreational uses has characterised the Eastern Slopes of the Rockies in Alberta. Land use change has been modest along agriculture-forest interface in Saskatchewan. Agriculture, however, has expanded in small isolated areas such as the Carrot River lowland in the east and the Lloydminster and Meadow Lake areas in the west. Furthermore, the number of non-farm residents has increased across much of the zone with a particular concentration of recreational activity in the Prince Albert region. The Interlake region and the section of the Winnipeg River east of Lake Winnipeg represent the main sub-areas of the agriculture-forest interface in Manitoba. In both cases, recreation and agriculture are displacing commercial forestry, trapping and hunting.

The dominant trend east of Manitoba is farmland abandonment and reversion of that land to bush (non-commercial forest), a process that has been widespread across northern and central Ontario. The Clay Belts are of particular significance in this regard because abandoned farmland represents a large potential reserve for the production of renewable resources should future needs arise. Five relatively small sub-areas of the agriculture-forest interface have been identified in Quebec mainly in peripheral eastern locations. Apart from the Huntingdon sub-area, where agriculture has expanded partly by conversion of peatlands to vegetable production, the general trend in these areas has been reforestation of former agricultural land. Many parts of New Brunswick, Nova Scotia and Newfoundland have experienced land use changes of a general nature associated with the agriculture-forest interface. Though significant locally, the scale of such changes has been smaller than most other provinces, because of the more limited agricultural land base in the Maritime Provinces.

## 5.3 Information Sources

Little information has been collected specifically for analysis of land use change at the agriculture-forest interface. But several data sources provide the basis for further investigations to be conducted at both the national and regional scales. At the national level, the Canadian Forest Resource Data System developed by the Forestry Statistics and Systems Branch of the Canadian Forestry Service, and agricultural data from both the Canadian Census of Agriculture and the Canada Land Inventory provide the opportunity for direct comparison, from 1981 onwards, of the areal extent of the agricultural and

forest land bases. The 1981 Canadian forest inventory (Bonnor, 1982) is the first such inventory to be computer-based and thus the first to have the capability of being readily combined with appropriate parts of the agricultural data base to produce an agriculture-forest data base for agricultural fringe areas. Prior to the 1980s, agricultural data were superior to forest data, the former having been collected on a systematic basis for census purposes. Satellite images provide a potentially useful record of land use change since 1972; aerial photographs are available only for selected parts of the agriculture-forest interface for 1960-62, 1970-72 and 1980-82 and thus could not be used as the basis for land use change detection in a national survey. They may, however, be used to verify the interpretation of satellite images as well as enabling detailed changes in land use to be monitored for relatively small areas.

The amount of data available on a regional basis varies widely from province to province and region to region. Alberta is most highly endowed with respect to data on agricultural land use change, having developed a computerised inventory for the period 1976 to 1981. Ontario has proposed a land cover map series based on digital processing of LANDSAT imagery; this has the potential for future land cover monitoring, should the series be repeated, but is of no value for reconstructing past changes. Other provinces have data bases covering relatively restricted geographic areas, such as Kent County in New Brunswick. In general, regions experiencing strong competition for land have the most complete sets of data available. The Peace River region, in particular, has a series of planning and related research studies that provide data on land use issues in the region in addition to the information sources outlined above.

## 5.4 Future Research Strategies

Two complementary approaches to further study have been proposed: a national overview and a case study approach. A reconnaissance level survey at the national level, based on data from the Census of Agriculture, the Canada Forest Resource Data System, the Canada Land Inventory and satellite imagery, provides the potential for monitoring changes to the agricultural and forest land bases.

Ideally past trends should be examined, but, because forest inventory data have been in computerised form only since 1981, future monitoring should be given highest priority, dating from an inventory for 1981. Some trends between 1971 and 1981 could be identified, however, using such provincial and federal forest inventory statistics as are available (see, for example, Bowen, 1978).

In order to obtain an indepth knowledge of the nature, causes and consequences of land use change, detailed analysis of recent land use change is proposed for selected sub-areas of the agriculture-forest interface. Given the sparseness of aerial photographic coverage for the early 1960s, it is recommended that a 1971 and 1981 study period be used. A tentative list of six study areas has been proposed to reflect the main regions of th country, the main types of land use change and the various land use issues: the Prince George region of British Columbia, the Peace River region of Alberta and

British Columbia, the Interlake area of Manitoba, the Clay Belt of Ontario, the Beauce region of Quebec, and a representative area in the Maritime Provinces, possibly in the eastern New Brunswick area studied by Mandale (1984). Particular attention should be focussed on those sub-areas which have undergone the highest rates of land use change during the period of study and for which adequate data are available. Monitoring detailed land use changes, analysing related socio-economic data and interviewing land owners and resource specialists at the regional and local levels for various types of sub-areas across the country would not only have the potential for corroborating general trends identified of the national level, but would also give insights into the factors influencing landowner decision-making which is important to an understanding of both regional and national issues.

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# APPENDICES

## APPENDIX 1

### Letter of Enquiry and Questionnaire Survey Form

Environment Canada Environnement Canada

Lands Directorate
Environment Canada
Ottawa, Ontario
K1A 0E7

Your file Votre référence

Our file Notre référence

August 31, 1983

Dear Colleague:

During the past few decades, major land use changes have occurred on the resource margins. For discussion purposes, the `resource margins' refer to the area near the edge of continuously settled areas of Canada -- at the interface between regions of primarily agricultural use and regions of predominantly woodland cover and forest use across Canada (please refer to attached map). The Lands Directorate of Environment Canada is now investigating the feasibility of completing land use change research on the resource margins.

Since your agency is involved in research, resource planning or land use issues concerning the resource margins, we would like to request your assistance in compiling sources of information related to this topic. Enclosed is a brief questionnaire on current issues and research activities regarding land use change on the resource margins. Would you please complete this questionnaire and then return it together with any papers, reports or references which you think may be useful, to us or Sandra Macenko, the principle investigator for this feasibility study.

Any information provided by you that is utilized in the feasibility study will be acknowledged and verified with you for accuracy. When it is completed, you will be sent a copy of the final report. If you have any questions concerning the study, please do not hesitate to contact Sandra Macenko at (819)997-2010. Your contribution will assist in making this publication more thorough. If at all possible, would you please return the questionnaire by September 19, 1983. Your assistance is greatly appreciated.

Sincerely,

Wayne K. Bond
Research Officer
Lands Directorate

David Gierman
Research Officer
Lands Directorate

Canada

In order to conserve energy and resources, this paper contains post-consumer fibre.

A des fins de conservation de l'énergie et des ressources ce paper contient des fibres recyclées.

**Land Use Change on the Resource Margins**
**(Inquiry regarding Information Sources)**

**Agency:**_____ **Contact:**_____

_____ _____

**Address:**_____ **Position Title:**_____

_____ _____

_____ _____

_____ **Tel. No.:**_____

**Note:** In the event insufficient space is provided for written response, please continue on back of page or attach additional sheets.

1) Please list research and planning activities (completed, current or future) which relate to land use change on the resource margins. For each project, please provide the title, the principal objective, a brief description and the time frame.

2) Please list land and resource related data bases which would assist the analysis of land use change on the resource margins. Please provide a brief description of these data bases (ie., coverage, scale, types of variables, analytical capabilities, computer based or not).

3) In your opinion, which areas of the resource margins (refer to map) are experiencing the highest rate or most significant land use change and warrant the attention of a land use monitoring program? Please specify the type(s) of land use change.

| Name of Area | Type of Land Use Change |
| --- | --- |

4) In your opinion, what are the major land and related resource issues and conflicts currently facing the resource margins in Canada? (You may focus on one region or consider the various regions across Canada)

5) In your opinion, which federal and/or provincial government programs are important influences on land use change and conflicts at the resource margins? (Again, you may focus on one province, or consider the various regions across Canada.)

6) If you can suggest other contacts currently involved in research or planning related to this topic, their names and addresses would be appreciated.

## APPENDIX 2

## List of Questionnaire Respondents and Interviews

## Respondents to Agriculture-Forestry Interface Survey

### British Columbia

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## APPENDIX 3

### Primary Data Sources

The following listing of data sources, by province and at the national level, was identified from bibliographic research and questionnaire respondents. The listing should not be regarded as exhaustive, because the wide range of departments and agencies involved in land use matters may lead to a series of rather dispersed sources. Cartographic and both computerised and traditional data bases, considered to have some potential value in an analysis of land use change and related issues at the agriculture-forest interface, are briefly described.

## British Columbia

Forest Inventory, Ministry of Forests - Forest inventory at a unit-survey standard has been completed for all the Crown-managed units in the province, and is maintained on a computer-based mapping system. Over 7,000 forest-cover maps and area-volume summaries by forest types are available. The inventory also includes: 1) the mapping of areas designated for environmental protection; 2) 53,000 ground sample plots measured to provide data for volume and stand development statistics; 3) approximately 400 mathematical equations developed to replace the volume-age curves; and 4) over 100,000 sample trees felled to provide estimates of volume, decay and waste. The system includes some land status information and the Inventory Branch monitors some land use changes. The Ministry is cooperating with the Ministry of Lands, Parks and Housing in developing an interactive system which relates land status data to the forest inventory.

Reference Maps, Ministry of Lands, Parks and Housing - A system of reference maps is maintained by the Ministry from which the status of all provincial lands (privately-owned, vacant, resource-tenured, reserved, etc.) can be derived through referenced records. The maps are currently in hard copy format although an automated mapping system is presently being implemented using the Interactive Graphic Display System. An automated record of selected attributes for lots in the primary lot survey of British Columbia also exists.

Crown Land Titles Inventory, Ministry of Lands, Parks and Housing - Development of this inventory has been approved by Cabinet; implementation is now being initiated. Details regarding general land status presently recorded include: survey information, file and record references, private vs. public ownership, location of easements/rights-of-way, areas under reserve and purpose, and resource allocations.

Assessment Roll, B.C. Assessment Authority - Microfiche coverage of land values by location is maintained for the entire province.

Agriculture Capability Mapping, Ministry of Agriculture and Food - Scale 1:50,000.

Wildlife and Fisheries Capability Mapping, Ministry of Environment - Various scales.

Land Use Maps, Regional District of Bulkley Nechako - The region retains one master copy of land use maps at scales of 1:2,400 to 1:20,000 covering most of the major settlements in the regional district.

Prince George Area Sub-District, Ministry of Lands, Parks and Housing - To produce the "Prince George Sub-District Crown Land Plan", the CLI, BCLI, Soils and Landforms and socio-economic statistics were utilized. In addition, field investigations were conducted to provide more site-specific information regarding arability, good forest sites, wintering areas, environmentally sensitive areas and rural subdivision sites. Scale 1:50,000 for an area 95 by 30 km. The information is not computer-based. The Ministry does not compile land and resource data bases that would be of value in the analysis of land use change except in the context of planning projects such as this one.

## Alberta

Timber Inventory, Alberta Forest Service, Alberta Energy and Natural Resources - The current phase of the timber inventory in the province is presently being completed. This computer-based inventory provides data on present vegetative cover and will be updated periodically for change. Nevertheless, it is not designed to produce statistics annually throughout the entire province on all change types. No system is known of within the province which does this. The inventory is mapped 1:15,000 scale and covers most of the forested area of the province (120,000 square miles).

Real Estate Land Title Changes, Alberta Agriculture - All rural land which undergoes legal transaction of land title is recorded on this computerized data base. Information available includes: legal description; assurance fund value; certificate of title number; predominant CLI class for the quarter section; registration data, and ownership status.

Major Changes to the Alberta Agricultural Land Base, Alberta Agriculture - A computerized data base of major changes (additions and subtractions) to the Alberta Agricultural Land Base. Information which is included on tape is: legal description; date of change; CLI; number of acres involved; and type of change, i.e. annexation.

Inventory of Public Lands, Alberta Energy and Natural Resources - Essentially details the status and availability of public land, such as whether the land is under disposition, reserved for a specific purpose, subject to land use restrictions, is vacant, or available for application for a specific purpose.

## Saskatchewan

Land Use Inventory Maps, Department of Parks and Renewable Resources - Scale 1:250,000/1:50,000.

Forest Inventory Maps, Department of Parks and Renewable Resources - Scale 1:50,000.

Land Disposition Inventory, Department of Parks and Renewable Resources - A computer-based inventory.

LANDSAT Imagery, Department of Parks and Renewable Resources - Coverage is retained at a scale of 1:250,000; computer systems applications are presently under consideration.

Inventory Maps, Department of Rural Development - Illustrate development and land use in each rural municipality. The maps are updated on a periodic basis.

Reconnaissance Terrain Inventory and Evaluation Study, Prince Albert Region, Department of Municipal Affairs - The Department initiated reconnaissance land inventory and evaluation studies in early 1978. The studies were designed to produce base data on terrain and geotechnical characteristics for use in urban and rural regional planning around the four largest cities in Saskatchewan. Each of the three regions studied (Regina-Moose Jaw, Saskatoon, and Prince Albert) were divided into four map sheets, each having a scale of 1:125,000. Air photographs flown in 1970 at a scale of 1:80,000 were used in preparing the airphoto mosaics and in interpreting and mapping the terrain.

## Manitoba

Physical Data, Parks Branch, Department of Natural Resources - The branch maintains data on: soils, drainage, vegetation (deciduous, coniferous, marsh), treed bog, treed rock, willow-alder, grasses, distribution of recreation types and users, impacted sites, vegetation regeneration, and landscape suitability for recreation criteria.

Crown Land Registry, Resource Allocation and Planning Branch, Department of Natural Resources - The Lands Branch registry is in the early stages of being computerized. It is supplemented by individual land files which are stored on microfiche. The registry includes an historic record of all lands patented as well as a current record of existing Crown land commitments through lease permits, easements, etc. The registry also shows the legal description of the land, type of original patent, and acreage dispositions. Information is updated on a daily basis.

Provincial Forest Inventory, Forestry Branch, Department of Natural Resources - An operational forest resource inventory for Manitoba which encompasses the agriculture-forest interface detailing both productive and non-productive forested land and non-forested land. The inventory is implemented on an approximate 15 year cycle.

Land Use and Property Ownership, Municipal Planning Branch, Department of Municipal Affairs - In the Beausejour region, the Department retains existing land use and property ownership information.

## Ontario

Forest Inventory, Ministry of Natural Resources - The inventory provides quantitative information regarding major tree species, attributes of forest stands including certain dimensions and age. The major land base divisions are: water, non-forested land, forested land, non-productive and productive land. The division of productive forested land into non-production and production components and their subdivisions is a refinement introduced for forest management agreement areas. This 20 year cycle inventory covers the entire province south of $52^{0}$.

Satellite Thematic Mapping Proposal, Ontario Centre for Remote Sensing - A feasibility study is presently ongoing to evaluate an OCRS proposal to publish a series of satellite thematic maps in colour, for the whole of Ontario. All maps are to be geographically referenced, including UTM grid. Three scales will be produced as required: 1:250,000; 1:100,000; and 1:50,000. In terms of forestry uses this series will provide: mapping of old and recent cutovers and burns, differentiation between bogs, fens, marshes and swamps, mapping of logging roads, a crude forest inventory (coniferous, deciduous, mixed), assessment of forest fuel areas and a working base onto which latest ground truth can be annotated. Agricultural uses include: mapping of woodlots, cropland and pastureland, monitoring foodland preservation (if series repeated), a companion map to compare with annual agricultural statistics and an indication of areas of erosion. The series may also be used for mapping wildlife habitat.

LEM 2 Crop Productivity, Land Evaluation Group, School of Rural Planning and Development, University of Guelph - A computerized data base containing modelled yield estimates for 18 crops on 13 types of land in 7 different climatic zones in Ontario.

LEM 2 Land Availability, Land Evaluation Group, School of Rural Planning and Development, University of Guelph - Selected data were obtained from the Canada Geographic Information System (CLI capability for agriculture, present land use, land supply, electoral boundaries); and using a procedure developed by the Land Evaluation Group, University of Guelph, these data were used to estimate the current availability of cleared land for agriculture in Northern and Eastern Ontario.

Forestry Agricultural Resource Inventory in Eastern Ontario (FARINEO) - From 1978 to 1980 the Ontario Ministries of Agriculture and Food (OMAF) and Natural Resources (MNR) undertook an inventory to record the existing forestry, agriculture and other land uses in the six eastern counties of Ontario (Grenville, Dundas, Stormont, Russell, Glengarry and Prescott). FARINEO was designed to 'provide resource data upon which recommendations would be based for the optimization of agricultural and forestry production in Eastern Ontario'. The complete inventory is composed of a series of five data overlays: 1. Agricultural and Non-Agricultural Land Uses; 2. Forest Lands; 3. Tile and Municipal Drainage; 4. Soil Capability for Agriculture (Canada Land Inventory) and; 5. Farm Building Codes.

Agricultural Resource Inventory, Capital Improvements Branch, Ontario Ministry of Agriculture and Food. A series of township maps, one series of which documents agricultural land use information and second, drainage systems. Rather than detailed field-by-field mapping, which quickly becomes dated, farming systems were identified and mapped for each 100 acre mapping unit. Seven different crop combinations/proportions were mapped using both aerial photos and field work, and the 1:50,000 NTS sheets as a base. The drainage inventory records the type, location and extent of both on-farm tile and municipal drainage systems.

Quebec

Carte Forestière, Ministère de L'Energie et des Ressources - Forest maps for the province have been prepared at scales of 1:20,000 and 1:50,000.

Land Use Maps, Office de planification et de développement du Québec (OPDQ) and the Ministère de Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ) - Produced in 1977, these maps cover the same area of Quebec as the 1965-68 CLI Land Use Maps.

Land Use Maps, Department of Municipal Affairs - The Department has undertaken a monitoring program of urban land use mapping for 91 urban regions (agglomérations urbaines, A.U.) in the province. It is intended to map the 91 urban regions every two or three years commencing in 1979.

Agricultural Zone Mapping, Commission de protection du territoire agricole - For the past three years, the Commission has been mapping the approved agricultural zones per municipality on a cadastral map (showing extent, ownership for taxation, and limits of the agricultural zone) at 1:20,000. The Commission is also considering verifying and mapping the evolution or change of land use in these agricultural zones during the past 5 years. Using air photographs (1979 to 1984 or 1980 to 1985, depending on years selected), the Commission would identify the evolution of land use in both agricultural and non-agricultural zones, e.g., vacant land (cleared land not being used), land going back into crops or agriculture, residential use following approved rezoning requests and vacant land in non-agricultural areas.

## New Brunswick

Land Use Inventory, New Brunswick Department of Agriculture and Rural Development - For the years 1979 and 1981, the inventory covers cleared land in New Brunswick at a scale of 1:10,000. Land use, crops, and approximately 9000 properties are retained in computer storage and manually drawn on orthophoto (1:10,000 where available) and aerial photo mosaics at approximately 1:20,000 scale for the rest of the province.

Forest Inventory, Department of Natural Resources, New Brunswick - The inventory includes forest type maps based on aerial photography and ground sampling, and is presently being mapped digitally.

Provincial Properties Data, Crown Lands Branch, Department of Natural Resources - The Provincial Properties Data Centre was set up within the Crown Lands Branch primarily to inventory and maintain an up-to-date record of all departmentally controlled lands (distinct from vacant or ungranted Crown and freehold lands). Within the last three years the Branch assumed the responsibility to inventory all provincially-controlled lands. The Branch has compiled 167 plans at a scale of approximately 1:31,000. These cadastral maps show a breakdown of the province into Crown and freehold lands, and represent the primary as opposed to present- day parcel breakdown. The present day parcel breakdown is shown on the property maps prepared by the Land Registration and Information Services (LRIS). The property mapping project is in progress with less than 50% of the province completed.

Forest Development Survey, Department of Natural Resources - A forest development survey was initiated by the Department in central New Brunswick, with about 775,000 hectares of forest land completed by 1981-1982. It is expected that the remainder of the province will be completed by 1987. The main purpose of this survey is to obtain detailed forest stand data for long term planning purposes.

Stand Development on Cut-Overs (A Survey), Department of Natural Resources - A survey to determine stand development on cut-overs was begun in 1981. Some 285 stands scheduled for clearcutting in 1981 were sampled for species composition and advance regeneration. DNR will monitor the development of these stands after harvesting on a five year remeasurement period. Eight stands clearcut 5 to 20 years ago were sampled to provide information on past clearcuts. These stands will also be resampled on a periodic basis.

Kent County Land Use Survey, Maritime Resource Management Service - The survey was conducted in 1982 to chart changes affecting cleared land since 1963. The data were plotted on computer at 1:10,000. Summary maps are available at smaller scales. Results are published in Mandale, 1984.

## Nova Scotia

Survey of cleared land in Nova Scotia's primary agricultural areas, 1979, 1980 and 1981, Nova Scotia Department of Municipal Affairs - Plotted in the field on 1:10,000 orthophoto maps and drafted for municipal planning uses, by the Community Planning Division, at the same scale. Both this survey and the Kent County, N.B. Land Use Survey included a classification of land uses which identified different intensities of agricultural land uses and different stages of reversion of agricultural land to woods.

Provincial Forest Inventory, Department of Lands and Forests - This inventory provides "statistical data on area of forest and non-forest type plus data on tree species by volume and various stand parameters. Information collected during 1981+ includes data on wildlife habitat components." The inventory covers the province of Nova Scotia for 1965-1971, 1972-1981 (excluding Cape Breton Island), 1981 and after. The information based on field measurement of sample plots is stored on magnetic tape and in printed reports. Updating is conducted on a 6 year basis for some plots and 10 years for others.

Rural Settlement Survey, Department of Municipal Affairs - This survey indicates the use made of all buildings in the rural areas of Nova Scotia. Towns and cities have been excluded. The overlay maps (at 1:10,000 scale on LRIS orthophoto bases) depict the buildings in a symbol format with some 19 symbols being used. The survey, which is conducted visual inspection, began in 1980 and is still in progress. About 5% of the province is left to be done. Similar to the agricultural land use survey, the maps are suitable for a GIS application, but only conventional statistical computer analysis has been attempted to date. Detailed mapped information is available for all of the resource margin areas in Nova Scotia.

Agricultural Land Use Survey, Department of Municipal Affairs, Nova Scotia - The purpose of this series of maps is to provide an accurate record of agriculture, particularly in the multi-crop and limited-use agricultural areas. Agricultural fields are identified and coded according to their present use. Apart from showing actively farmed lands, the survey also identifies idle land, restocking land (natural regrowth of trees and shrubs) and newly cleared land. Data are obtained through air photo interpretation and visual field inspection. Information is mapped in overlay form at a scale of 1:10,000 on Land Registration and Information Service (LRIS) orthophoto bases. The field area by category by 1:10,000 LRIS map sheet generated from the survey is being computerized in conventional format (not GIS). The mapping itself is conducive to a GIS application; however, no firm steps have yet been taken in that direction. The survey began in 1979 and is still in progress. Areas of the province covered to date include: Annapolis, Antigonish, Colchester, Cumberland, Halifax (portion), Hants and Kings Counties. About 10% of the province is left to be done. Detailed information is available for most of the areas identified as resource margins in Nova Scotia.

## Newfoundland

Newfoundland Forest Inventory, Department of Forest Resources and Lands - The objectives of this ongoing inventory are: to provide statistics on forest land areas and timber volumes, and to map the location and extent of forest types in order to facilitate management planning for each of the management units; to provide data on forest growth rates for the determination of annual allowable cut by management unit; and to provide cull and decay data. The inventory is based on the interpretation of aerial photographs which is verified by statistically suitable ground checking following stratified random sampling techniques. All measurements are in metric units, and the terminology used is consistent with recommendations of the Canadian Forest Inventory Committee. Forest inventory data have been processed for ten management units, and are in various stages of completion for four others. The initial inventory is scheduled for completion in 1984. The re-inventory cycle is scheduled to begin in 1985.

Crown Lands Registry, Department of Forest Resources and Lands - Includes a record of leased and granted lands. Details recorded in the Crown land inventory include: property survey by registered land surveyor; purpose for which the land was originally titled; legal description, plot plan, metres and bounds; lease requirements; and lease updates. The Crown land inventory is currently stored in hard copy format although a microfiche record is being developed. Updating of the inventory is conducted manually.

## Federal Government

Meteorological and climatological data/drying index, Canadian Climate Centre, Atmospheric Environment Service, Environment Canada (Downsview, Ontario) - Meteorological and climatological data are available in published form and on computer tape for all of Canada. The data range from individual observations to ` -year (and longer) averages or "normals".

Canadian Forest Inventory, Forestry Statistics and Systems Branch (FSSB), Canadian Forestry Service, Environment Canada - Inventory data are obtained from provincial and federal forest agencies and summarized using the Canadian Forest Resource Data System (CFRDS), which is a computer-based system for the input, manipulation and output of forest resource data. The basic data are summarized by "cells" or areas having a target size of 100 km². These cells are used by the provinces or territories for summary purposes and may be townships or map sheets. Across Canada about 40,000 cells are used to store the inventory data. The summary output is in the form of tables and choropleth maps, both of which are generated by computer (Bonnor: 1982).

Canada Land Inventory, Environment Canada - Provides land capability and present land use information for reconnaissance level resource and land use planning purposes. The assessment of land capability on a seven class scale has been completed for agriculture, forestry, recreation, and wildlife. The present land use information relates to the 1966 to 1968 period and uses a mixed activity-cover classification. The inventory covers approximately 2.6 million square kilometres and includes the settled and forest fringe areas of Canada (Environment Canada, Lands Directorate: Unpublished Discussion Paper Canada Land Use Monitoring Program).

Census of Population, Statistics Canada - Provides data on population size and change, number of households, and number and type of dwelling units for enumeration areas. This information can be used to estimate rates of change in settlements. Specific information about residential settlement patterns or the relationship between residential and other land uses cannot be obtained from the census (Ibid).

Census of Agriculture, Statistics Canada - Provides information on agricultural land use at the enumeration area level and also generates data on certain land cover, land activity and land tenure types. In addition, other socio-economic information, such as farm sales, farm income, value of land and buildings, can be obtained through the census. Although it is not possible to trace sequential changes in land use for specific land parcels, the census of

agriculture data does allow the overall detection of trends in agricultural land use. From this, it is possible to identify areas for more specific land use change studies (Ibid).

Central Real Property Inventory, Public Works Canada (PWC) - This inventory includes a record of the real property holdings of the federal government by department or agency, by province, by constituency and by asset classification. Details which are recorded regarding land holdings include hectareage, date of original acquisition, types of buildings on the property, date of the last acquisition and whether the property is leased or owned outright. Annual update of the inventory is required, although PWC updates the inventory on a monthly basis based on inputs received from departments throughout the year (Macenko & Neimanis: 1983).

Federal Land Mapping Project, Environment Canada - This project, currently approaching completion, is composed of data derived primarily from the Central Real Property Inventory and will enable analyses to incorporate the spatial dimension to federal land information. This information can be interfaced with other data sets including the Canada Land Inventory and census data through the Canada Geographic Information System. Currently requests for information from the federal land mapping project are manually processed, pending its complete computerization.

Area Screening Canada Program - Established by Public Works Canada, as agent for the Treasury Board, this program is responsible for the review of federal land holdings on a regular cycle and to identify those lands with an apparent potential for improved use. The Treasury Board Advisory Committee on Federal Land Management reviews and authorizes the implementation of each annual program of ASC studies (Macenko & Neimanis: 1983). Each individual study includes a map of government land holdings, an urban profile and information on social, economic and environmental factors.

CANSIM, Canadian Socio-Economic Information, Statistics Canada - A statistical data bank accessible interactively and in batch mode, which contains more than 325,000 time series data and a separate, cross-classified bank of socio-economic data, including census information.

Census of Agriculture, Statistics Canada - Every five years, Statistics Canada conducts a survey of all Canadian farms which yields information on important aspects of the structure of farming in Canada, including land use and inventories of crops, livestock, buildings and machinery.

Census of Population and Housing, Statistics Canada - In years ending with a one or a six, Statistics Canada conducts a survey of all Canadians which provides basic demographic measures as well as information on language, education, labour force activity, and characteristics of dwellings and households. In years ending with a one, additional information is made available on ethnicity, immigration, occupations, income and shelter expenditures. All data are available in printed, microfiche and machine-readable formats for diverse geographical census areas.

Crown Land/Transaction Recording, Indian and Inuit Affairs - The Department records evidence of the Crown's interest in Crown lands. It procures land for Indian program use (school residence and agency lands).

Indian and Crown Lands/Register, Indian and Inuit Affairs - The Department keeps records of interests and transactions affecting those interests, and provides certified documents showing evidence of interest in Indian and Crown lands of Canada to bands, individual band members, lawyers and/or agents of bands, officials of the Department of Justice, and the courts.

## APPENDIX 4

### Studies and Reports that Serve as a Basis for Land Planning and Management at the Agriculture-Forest Interface

The following information was largely obtained from questionnaire returns and to a lesser extent from bibliographic research. Given the dispersed nature of works relating to land planning and management, and the exploratory nature of this study, the listing should not be regarded as exhaustive.

APPENDIX 4

| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| <u>British Columbia</u> | | | |
| "Forest and Range Resource Analysis" | Ministry of Forests, Victoria, British Columbia | First analysis completed 1979; current analysis to be submitted September 30, 1989 | Objective: To determine the timber and forage supply problems within the province. The first analysis included a report of "resource interactions" affecting timber, range and recreation for each region studied. Land use change at the agriculture-forest interface is predicted as a major topic in the current analysis. |
| "Provincial Forests" | Ministry of Forests, Victoria, British Columbia | ongoing | Those areas that are best managed for forest and range uses are being designated as provincial forests to give some protection from alienation to other uses. |
| "Deferred Planning Areas" | Ministry of Forests and Ministry of Lands, Parks and Housing, Victoria, British Columbia | Program essentially complete as of September 1983 | A joint planning procedure between the two ministries to resolve land allocation problems involving competition for the use of land by forestry, agriculture and recreational uses. The Ministry of Lands, Parks and Housing sub-district level of planning was applied to 34 areas throughout the interior of British Columbia to determine the most appropriate land use, thereby involving trade-offs between agriculture, forestry and recreation. |
| "A Methodology for Including Economic Criteria in the Crown Land Forestry/Agriculture Allocation Process" | Prepared for the Ministry of Lands, Parks and Housing by Canadian Resourcecon Limited, Victoria, British Columbia | completed 1982 | Objective: To apply an economic methodology to supplement biophysically-based land allocation mechanisms. Forage and timber producing capabilities of soil associations were grouped into 'landscape units' for an area in the Cariboo region of British Columbia. Net economic returns from forage and timber production on a per hectare per year basis were then derived for each landscape unit. |

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| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| British Columbia (Cont'd) | | | |
| "Compendium of Comments on a Methodology for Including Economic Criteria in the Crown Land Forestry/ Agriculture Allocation Process" | Ministry of Lands, Parks and Housing, Victoria, British Columbia | completed April 1983 | A compilation of comments and responses of various provincial government agencies, federal agencies and interest groups who were distributed copies of the above study. The more critical briefs came from agricultural interests and the less critical ones came from forestry interests. |
| "Crown Land Planning" | | | Crown land planning is a hierarchical planning program involving broad to detailed levels of planning. It includes an analysis of land supply and demand within a broad spectrum of environmental, social and economic parameters. The Ministry has numerous plans in various stages of completion, many of which will result in land use change, typically from forestry to agriculture. |
| - Prince George Area Sub-District Crown Land Plan | Ministry of Lands, Parks and Housing, Victoria, British Columbia | completed 1981 | Recommendations for the Prince George Crown Land Plan are currently being implemented. Principal objective: To resolve land/resource use conflicts in the Prince George area and to facilitate the allocation, management and disposition of Crown land. |
| - Vanderhoof Area to Crown Land Plan | Ministry of Lands, Parks and Housing, Victoria, British Columbia | February 1984 completion | Undertaken for reasons similar the Prince George Area Sub-District Crown Land Plan, the plan is intended to determine the best land use for the remainder of Crown land in the settlement corridor near Vanderhoof. Land is to be allocated for agriculture, forestry, rural residential, fish and wildlife, recreation and aggregates. |

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| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| Alberta | | | |
| "Integrated Resource Management Planning" | Alberta Energy and Natural Resources | ongoing | Intended to designate and integrate uses of public lands in Alberta. A number of the current plans are examining the agriculture-forest interface. Examples include the following sub-regional plans: Big Bend, covering an area of agricultural expansion, the Lakeland area (recreation development) and the Nordegg-Red Deer River area (timber development). |
| "Peace River Situation Appraisal" | Alberta Energy and Natural Resources | completed 1983 | A situation appraisal process was selected by the Peace River Regional Resource Management Committee, as a method to survey systematically the region's resource management environment. It provides a list of issues based on scale, sector and priority and direction for the resolution of conflicts and problems. |
| "Agricultural Expansion in the Peace River Region of Alberta--Some Resource, Environmental and Socio-economic Costs" | Alberta Energy and Natural Resources | completed 1983 | Prepared for the Agricultural Institute of Canada National Conference; this study identifies the cost factors associated with opening forested land for agriculture in the Peace River region of Alberta and describes how these costs enter into the government's decision-making processes for expanding the agricultural land base. |
| "A Policy for Resource Management of the Eastern Slopes" | Alberta Energy and Natural Resources | released 1977; administrative review completed 1983 | An integrated resource planning approach for the management of the Eastern Slopes. |

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| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| Alberta (Cont'd) | | | |
| "Maintenance and Expansion of the Agricultural Land Base in Alberta" | Environment Council of Alberta | Report and recommendations anticipated late 1984 | The Environment Council of Alberta recently held public hearings at suitable locations in Alberta to "enquire into means for maintaining and expanding the Alberta agricultural land base and for maximizing its production." A series of background reports (annotated in the bibliography of this study) have been published by the ECA in conjunction with these hearings. |
| "An Inventory of Changes in Alberta's Land Base 1976-1980" | Resource Economics Branch, Alberta Agriculture | completed 1982 | A study to provide accurate and comprehensive information on land being added to or removed from agriculture. |
| "An Inventory of Changes in Alberta's Agricultural Land Base 1981" | Resource Economics Branch, Alberta Agriculture | completed 1983 | An update of the above study. |
| "Potential for Agricultural Expansion Relative to Forestry in Northern Alberta" | Resource Economics Branch, Alberta Agriculture | completed 1983 | The study was conducted to compare the economics of converting a block of forested land to agricultural use as opposed to maintaining the forest in its current state. |
| "Farming Potential of the Jean D'Or Prairie Area: An Economic Assessment" | Resource Economics Branch, Alberta Agriculture | completed 1981 | To assess, in economic terms, the potential of the Jean D'Or Study area for agricultural use by individual, commercial farmers. |
| "Economic Analysis of Various Alternatives for Expanding or Intensifying Agricultural Production in Alberta" | Resource Economics Branch, Alberta Agriculture | interim report April 1984; final report April 1985 | The project is currently under study. |

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| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| **Saskatchewan** | | | |
| "Resource Lands and Planning Management Strategy" | Department of Parks and Renewable Resources | ongoing | A general strategy for an integrated planning and management program for Crown resource lands in Saskatchewan. The strategy will include: baseline data research; policy formulation for land and associated resource management; and monitoring and update of integrated resource management strategies and guidelines. Examples of projects include: The Key Lake Road Corridor Land Resource Plan; Land Management Guidelines; Resource Access Roads Policy; Recreation Systems (Parks) Overview and Strategy; and the Provincial Cottage Lot Program. |
| "Changes in Land Cover in the West Central Area 1966-1981" | Saskatchewan Urban Affairs | completed 1982 | The study compared areas of land cover in the Lloydminster region classified under the various land use categories outlined by the CLI and surveyed in 1966, with areas of land cover surveyed under the auspices of Saskatchewan Urban Affairs, in 1981. The primary focus of the comparison is on changes in the amount of woodlands, grasses and rough pasture land as well as the increases in improved land uses. For bush and tree cover, a clearing of 33,771.6 ha or approximately 58.5% was found in the study region within the fifteen year period. |
| "Land Use and Land Cover Research Mapping Project Based on Remotely Sensed Data--North Battleford-Lloydminster | *J.D. Mollard and Associates Ltd. under contract with Saskatchewan Urban Affairs | completed 1981 | A land cover research project based on remotely sensed data and air photo interpretation in the North Battleford-Lloydminster Region. The area covered by the project extends from 108°00' to 110°00' longitude and from 52°30' to approximately 53°40' latitude. |

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| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| Manitoba | | | |
| "Crown Land Classification Plans" | Crown Land Classification Committee | ongoing since 1975 | The Committee has systematically prepared Crown Land Classification Plans for southern Manitoba including much of the agriculture-forest interface. Plans prepared by the Committee include "Provincial Crown Land Plans"--essentially general guideline plans and "Operational Plans"--detailed classification coding on a quarter section basis.<br><br>Plans in the final stages of completion include the Washow-Fisher and Catfish Creek land use studies designed to allocate Crown land and natural resources in the area. Other recent plans cover the Winnipeg River, Lac du Bonnet and North Interlake areas. |
| "East Side of Lake Winnipeg--Overview Plan and Interim Management Guidelines" | Resource Allocation and Planning Branch, Department of Natural Resources | completed | The objective of this plan was to minimize present and potential land use/resource management conflicts. |
| "North Interlake Overview Plan" | Resource Allocation and Planning Branch, Department of Natural Resources. | completion 1984 | Similar objectives as above. |
| "Winnipeg River Planning District Development Plan" | Municipal Planning Branch, Municipal Affairs Department | completion late 1985 | Objective: To prepare a set of land use policies and appropriate implementing tools for the District's Planning Board. Involves preparing background studies covering natural resources, agriculture, recreation, transportation, urban centres, rural land use, mineral resources, historical resources and related socio-economic data. |

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| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| Ontario | | | |
| "Agricultural Land Use on the Southern Canadian Shield in Ontario" | Helen E. Parson, Department of Geography, Wilfred Laurier University | ongoing | An analysis of land use and settlement trends on the section of the shield between the Ottawa River and Georgian Bay from the 1850's to the present. Includes detailed analysis of census statistics for 1921, 1951 and 1981. |
| "Conditions Affecting Evaluation of Lands for Agriculture in Northern and Eastern Ontario" | Land Evaluation Group School of Rural Planning and Development, University of Guelph under contract to the Land Resource Research Institute, Agriculture Canada, with additional support from the Ontario Ministry of Agriculture and Food | completed 1982 | Objective: To assess the potential impacts of selected regional development initiatives in Northern and Eastern Ontario on future land needs for agriculture in these and other regions of the province. The extent to which the existing land base in each region could support expansion of the agri-food sector was determined, and the impact of selected development initiatives in these regions on agricultural land use options throughout Ontario were examined. |
| "Agriculture in Northern Ontario" | J.M. Troughton, Department of Geography, University of Western Ontario | ongoing | A review of the advance and retreat of agricultural settlement in Northern Ontario from the late 19th century to present day (1981 census). Part of ongoing research into agriculture in marginal areas--specifically in connection with the I.G.U. Sub-Commission on Problems of Rural Development in Highland and High-Latitude Areas. |

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| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| Ontario (Cont'd) | | | |
| "Strategic Land Use Plans" | Ministry of Natural Resources | released in 1982 | Three Strategic Land Use Plans (Northwestern Ontario, Northeastern Ontario and Southern Ontario) were produced to identify the policies and objectives of individual programs of the Ministry, and integrate these into a comprehensive conceptual land use plan which will both identify and help resolve conflicting demands in the region's land and water base, and at the same time provide an overall strategy within which District Land Use Plans (released in 1983) will operate. |
| "Satellite Thematic Mapping Proposal" | Ontario Centre for Remote Sensing | ongoing feasibility study completion December 1983 | Proposal to publish a series of satellite thematic maps in colour, for the whole of Ontario. All maps are to be geographically referenced including UTM grid. Proposed forestry uses include mapping of old and recent cutovers and burns. Monitoring of foodland preservation is proposed if the series is repeated. |
| "Forestry Agricultural Resource Inventory in Eastern Ontario (FARINEO) | Ministry of Agriculture and Food, and Ministry of Natural Resources | 1978 to 1980 | An inventory which recorded existing forestry, agriculture and other land uses in six Eastern Ontario counties. Designed to provide resource data upon which recommendations would be based for the optimization of agricultural and forestry production in Eastern Ontario (part of New Forests in Eastern Ontario Program). |

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| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| Quebec | | | |
| "Land Use Mapping" | Office de planification et de développement du Québec (OPDQ) and the Ministère de Agriculture, des Pêcherie et de l'Alimentation du Québec (MAPAQ) | 1977 | Land use maps which cover the same area as the 1965-68 CLI Land Use Maps. |
| "Evolution récente de l'espace rural au Saguenay-Lac-St-Jean" | M.J. Gauthier, Les Laboratoires de géographie, Université du Québec à Chicoutimi | completed 1981 (UQAC) | Thèse de doctorat de 3e cycle. |
| "Atlas régional du Saquenay-Lac-St-Jean" | G. Morin, ed., Les Laboratoires de géographie, UQAC | completed 1981 | |
| "Agricultural Zone Mapping" | Commission de protection du territoire agricole | ongoing since 1980 | Mapping of approved agricultural zones by municipality (indicating extent, and ownership for taxation) on cadastral maps at a scale of 1:20,000. The Commission is considering verifying and mapping the evolution or change of land use in these agricultural zones during the past five years. Aerial photography from 1979 to 1984 or from 1980 to 1985 would be used for this study. The evolution of land use in both agricultural and non-agricultural zones would be identified, e.g., cleared land not being used, land returning to agricultural use, residential use following approved rezoning requests and vacant land in non-agricultural areas. |

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| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| **New Brunswick** | | | |
| "Land Use Policy: A Positive Approach" | Land Use Policy Task Force 1982 for the Cabinet Committee on Economic Development | completed 1982 | The Task Force was established in September 1981 to prepare a draft Land Use Policy and to make recommendations for its implementation. The policy is intended to 'provide a common framework for the Government's many and sometimes conflicting activities which affect the use of land'. |
| "Official Plans--Pointe Verte, Jacquet River, Belledune" | Commission d'urbanisme de Belledune | 1983 | Official plans have been adopted by all three of these villages. |
| "Research--Dynamics of Forest Development" | Faculty of Forestry, University of New Brunswick | ongoing | A substantial proportion of staff and graduate student research is in the agriculture-forest interface area. Most of the research relates to the dynamics of forest development. The Faculty is currently engaged in a major land-use planning exercise with the Canadian Forces on their Tracadie Range. This project is under the direction of Professor D. Walker. |
| **Nova Scotia** | | | |
| "The Agricultural Industry of the Northumberland Lowland Region, Cumberland County, Nova Scotia" | Maurice Mandale for the Cumberland District Planning Commission, Amherst, Nova Scotia | completed 1980 | An assessment of the physical and socio-economic factors influencing agricultural development in the study area, to assist in the preparation of rural plans. |
| **Newfoundland** | | | |
| "Land Use Conflicts and the Alienation of Productive Forest Lands in Newfoundland" | K. Storey, Department of Geography, Memorial University of Newfoundland | Project to run in two phases from Sept. 1, 1983 to March 31, 1985 | The objective is to develop a set of criteria and a procedural model to provide a basis for the resolution of land use conflicts and the alienation of productive forest lands in Newfoundland. It is hoped that the research will go some way to providing the basis for a land classification system in Newfoundland. |

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| Research and/or Planning Activity | Agency | Status | Objective(s)/Description |
|---|---|---|---|
| Newfoundland (Cont'd) | | | |
| "Report of the Royal Commission on Forest Protection and Management" | Royal Commission on Forest Protection and Management | completed 1981 | The Commission, constituted on April 23, 1980, undertook a review of the available literature on all aspects of forest protection and management and made arrangements to request submissions. Seventeen days of public hearings were held at nine centres in Newfoundland and Labrador. The report was released in two parts: Part II examines the question of forest management in the Province. |
| "Forest Management Plans" | Department of Forest Resources and Lands | ongoing | The policy of the Provincial Government to place all Provincial forest lands under sustained yield management is being implemented through a system of control by management units. Management plans are normally written for a ten-year period. |
| "Assessment of Management Unit Boundaries and Productive Forest Land Alienations in Central Newfoundland" | Northland Associates Ltd. | completed 1982 | Report to the Department of Forest Resources and Lands, Government of Newfoundland and Labrador. |
| Crown Land Plans | Department of Forest Resources and Lands | ongoing | The objectives of the Land Management Division for Crown Land Planning are to "initiate and develop integrated land management plans for the Province's Crown lands." The Southern Shore and Central Avalon Plans, quoted in this study, are examples of such plans. |

## APPENDIX 5

## Annotated Bibliography

## ANNOTATED BIBLIOGRAPHY


Alberta Agriculture. 1983a. Potential for Agricultural Expansion Relative to Forestry in Northern Alberta. Kathleen MacDonald, Resource Economics Branch. Technical Report 83-06-01. Edmonton, Alberta.

The purpose of the study is to compare the economics of converting a block of forested land to agricultural use as opposed to maintaining the forest in its present state. Costs and returns for logging and sawmilling were estimated through interviews with companies operating in a study area of 437,760 acres lying east of the Peace River and north of Three Creeks Grazing Reserve. Major findings of the study include: 1) conversion of the study area from forestry to agriculture would entail a cost of $53 million to provide roads and power, with access from the south via Three Creeks; 2) currently high production costs and restricted prices are producing minimal or negative returns. Losses of up to $26.00 per thousand board feet were estimated for the last timber year. Returns over cash costs of $21,700 and net returns after depreciation of $4,000 were determined for a 500 acre farm; and 3) on the basis of the results of partial economic analysis alone, this project would not be feasible. However, in making an investment decision, a number of other considerations must be taken into account. The loss of secondary benefits of forests and the gain of induced benefits from the project must be evaluated against the high cost of providing the necessary infrastructure.

Alberta Agriculture. 1983b. An Inventory of Changes in Alberta's Agricultural Land Base 1981. Peter Woloshyn, Resource Economics Branch, Alberta Agriculture Project Report RE-13-06-83. Edmonton, Alberta.

This study is an update of An Inventory of Changes in Alberta's Agricultural Land Base between 1976 and 1980. Comprehensive data showing the type and rate of land use conversion in the agricultural land base is provided for 1981. A format similar to the earlier study has been utilized and consistency retained where possible.

Alberta Agriculture. 1982. An Inventory of Changes in Alberta's Agricultural Land Base Between 1976 and 1980. Alfred Birch, Resource Economics Branch, Alberta Agriculture. 90 pages.

This project was intended to provide accurate and comprehensive information on land being added to and removed from agriculture. A computerized inventory of agricultural land use changes between 1976 and 1980 was developed and included the following information: 1) amount of land being converted to or from agriculture; 2) the intended use categories of the land being removed from agriculture; 3) the date of recorded change of use; 4) the location of the land being converted; and 5) the Canada Land Inventory Classification for agricultural purposes, of the affected land.

Alberta Agriculture. 1981. Farming Potential of the Jean D'Or Prairie Area: An Economic Assessment. Frank Hanus,

Resource Economics Branch, Edmonton, Alberta.

The Jean D'Or study was identified by the Lower Peace River Regional Overview Study, as the area containing the largest amount of potentially developable farmlands in the vicinity of Fort Vermillion and the Beaver Ranch Indian Reserve. In 1980, an integrated land use planning team, under the direction of the Resource Planning Branch of Energy and Natural Resources was formed. The primary purpose of the integrated land use planning process is to re-define the location of the Yellow-Green Area boundary and to identify the lands most suitable for agricultural use, while considering the other uses of the land. In the context of this process, the purpose of this report is to assess, in economic terms, the potential of the Jean D'Or study area for agricultural use by individual, commercial farmers. Soil productivity was assessed, size of farm unit for economic operation on each soil class was determined and capital investment required to convert tree-covered public land into farm units was estimated.

Alberta Agriculture. 1974. A Study on the Use of Agricultural Land for Recreation Purposes. W.S. Pattison. Alberta Land Use Forum Technical Report No. 2. Edmonton, Alberta.

This study was undertaken to determine the extent to which privately owned or leased agricultural lands in Alberta are used for recreational purposes and the effects on land owners. Secondary objectives of the study were to project future trends in, and assess the implications of, nonagricultural use of farm land and to define alternative action to bring about greater utilization of the land resource. The study was conducted by a sample survey of Alberta households on a regional rural and urban basis by mailing questionnaires.

Alberta Energy and Natural Resources. 1983a. Peace River Situation Appraisal Analysis of Resource Management Issues. Edmonton, Alberta.

A wide variety of resource management pressures have confronted the Peace River Region in recent years. As a result, the Peace River Regional Resource Management Committee and the Resource Planning Branch, ENR conducted an overview study of the resources, their management, and present and potential conflicts in the region. The situation appraisal process was selected to survey systematically the region's resource management environment. The report lists 58 resource management concerns or issues based on scale, sector and priority. It also provides direction for the resolution of conflicts and problems.

Alberta Energy and Natural Resources. 1983b. Peace River Situation Appraisal Summary of Resource Information. Edmonton, Alberta.

Substantial information was compiled during the period of February 1982 to April 1982 for the Peace River Situation Appraisal. This report provides a summary of information gathered regarding the physical environment, population and the economy. Summaries are also provided by sector including:

agriculture, forestry, wildlife resources, grazing and recreation. More detailed files of information and/or direction to original data files can be obtained through the Regional Resource Co-ordinator, Peace River Region.

Alberta. Energy and Natural Resources. 1983c. "Agricultural Expansion in the Peace River Region of Alberta - Some Resource, Environmental and Socioeconomic Costs." J. Rivait and K. Leggat. Preliminary Draft. Edmonton, Alberta.

This paper outlines programs that have been implemented in Alberta to develop public land for agriculture. It also describes social, economic and environmental costs plus costs to other resource uses related to the extension of agriculture on the formerly forested land in the Peace River region. In addition, the paper describes how the provincial government's decision-making processes take into account such costs. The Jean D'Or Prairie Planning Area is examined as a case study of the cost/benefit viability of agricultural expansion.

Alberta. Energy and Natural Resources. 1981. Alberta Public Lands. Public Lands Division. Edmonton, Alberta.

This document provides an overview of Alberta public land management for the "White", "Yellow" and "Green" areas. The management of fish and wildlife resources, land use planning for public lands, reclamation of public lands, access restrictions and the Provincial Grazing Reserve Program are also discussed.

Alberta. Energy and Natural Resources. 1978a. Biophysical Analysis and Evaluation of Capability Little Smoky Area. ENR Report No. 60. Edmonton, Alberta.

Agricultural expansion is responsible for increased pressure on Crown lands in the Little Smoky Area resulting in a potential conflict with forest management. The Little Smoky area encompasses approximately 2720 square kilometres and is located in the southeastern Peace River area. It is intended that this biophysical analysis will assist in the definition of lands suitable for agriculture, forestry, and other uses. Aerial photographs were used to identify ecological units.

Alberta. Energy and Natural Resources. 1978b. Biophysical Analysis and Evaluation of Capability Whitecourt Area. ENR Report No. 61. Edmonton, Alberta.

In early 1975 the Forestry Division and the Fish and Wildlife Division of the Department of Lands and Forests requested the Land Use Assignment Committee to provide a biophysical report for an area south of the town of Whitecourt to approximately six miles north of the Edmonton-Jasper Highway. The main emphasis of "biophysical analysis" is to divide and classify the land surface into areas of similar environment. This report was intended to assist the Forestry Division resolve the boundaries of the proposed Whitecourt Community Forest and, to provide further information regarding Wildlife Division concerns about possible conflicts between ungulate production and an expanding agricultural base, particularly grazing leases.

Alberta. Energy and Natural Resources. 1977. A Policy for Resource Management of the Eastern Slopes.

Growing pressures for resource and land use in the Eastern Slopes area of Alberta led to an integrated resource planning approach for management of this area. The approach was formalized with the release of this policy which is currently under administrative review, scheduled for completion in December 1983.

Alberta. Department of Municipal Affairs. 1974. Peers-Whitecourt Land Use Study. Edmonton, Alberta.

The objective of this study was to present a "meaningful optimum land use plan" to the various government bodies responsible for the administration of the Peers- Whitecourt area. Prior to the commencement of this study, numerous requests for grazing and agricultural permits as well as applications for country residential and recreational uses were being submitted for lands located in the Peers-Whitecourt area. A lack of detailed information in the area presented a problem to government officials ruling on these matters. The plan analyzes the physical, economic and social aspects of the sub-region in an attempt to indicate the highest and best use of each quarter section of land throughout the study area. The study area is small but typical of areas where competition for land is increasing.

Beattie, K.G., W.K. Bond, and E.W. Manning. 1981. The Agricultural Use of Marginal Lands: A Review and Bibliography. Working Paper No. 13. Lands Directorate, Environment Canada. Ottawa, Ontario.

A key review of the geographic areas and general processes operating in areas of marginal agriculture. A distinction is made between the expanding margins in the west and the retreating margins in the east of the country.

Bonnor, G.M. 1983. "Computers, Mapping and National Forestry Statistics." Canadian Forest Industries. Volume 103, No. 6, pp. 18-20.

This paper describes activities in the Forestry Statistics and Systems Branch of the Canadian Forestry Service to provide better forest resource data on the national level. It describes briefly the Canadian Forest Resource Data System and focuses on the use of computers, particularly computer-assisted production of maps and summary data.

Bonnor, G.M. 1982. Canada's Forest Inventory, 1981, Forestry Statistics and Systems Branch, Canadian Forestry Service, Department of the Environment.

A tabular and cartographic presentation of the country's forest resource statistics.

British Columbia. Ministry of Agriculture and Food, and Canada. Department of Regional Economic Expansion. 1980. Regional Profile series. Regional Development Plans Project No. 271024 under Canada, British Columbia Subsidiary Agreement on Agriculture and Rural Development.

A series of reports covering British Columbia by the following eighteen District Agriculturists' Office Areas: Williams Lake, Vernon, Vanderhoof,

Smithers, Salmon Arm, Quesnel, Prince George, Oliver, Kamloops, Fort St. John, Duncan, Dawson Creek, Creston, Cranbrook, Courtenay, Cloverdale, Chilliwack and Abbotsford. The reports are primarily descriptive consisting of statistical information derived from a number of sources. The documents are designed as an information base for district goal identification and program planning by Ministry staff. Each report provides information on resources and infrastructure of the district followed by an outline of the current agricultural situation of the area.

British Columbia. Ministry of Agriculture. 1978. Agriculture in the Peace River. Publication of the British Columbia Ministry of Agriculture No. 78-10. Victoria, British Columbia.

British Columbia. Ministry of Forests. 1981. Timber Supply Management in British Columbia: Past, Present and Future. Burgess-Land Memorial Lecture, University of British Columbia, October 29, 1981. Presented by W. Young, Chief Forester, Ministry of Forests. Victoria, British Columbia.

Timber supply management in British Columbia is divided into three eras: 1) The unregulated era or the pre-1945 years; 2) The yield control era, 1946-1978; and 3) The current era. Each of these eras is reviewed in the context of how they have shaped current timber supply problems.

British Columbia. Ministry of Forests. 1980a. Provincial Forests. Multiple Use of B.C.'s Forest and Range Resources. Victoria, British Columbia.

A brief public information document summarizing the designation and management of Provincial Forests and the inherent implications for public use.

British Columbia. Ministry of Forests. 1980b. Forest and Range Resource Analysis and Five-Year Program Summary.

A summary of three reports which make up the Resource Analysis and Program: The Forest and Range Resource Analysis; the Five Year Forest and Range Resource Program; and the Forest and Range Resource Analysis Technical Report.

British Columbia. Ministry of Forests. 1980c. Forest and Range Resource Analysis Technical Report. Volumes I and II.

In British Columbia, the Ministry of Forest Act requires the Ministry to provide the legislature with a statement of the condition of the resources under their management. The first Forest and Range Analysis was completed in 1979 to "determine the timber and forage resource supply problems within the province." Resource interactions and issues are identified on a regional basis. The current analysis is scheduled for submission on September 30, 1989.

British Columbia. Ministry of Lands, Parks and Housing. 1983. "Compendium of Comments on a Methodology for Including Economic Criteria in the Crown Land Forestry/Agriculture Allocation Process." Victoria, British Columbia.

A compilation of comments and responses

of various provincial government agencies, federal agencies and interest groups to a report prepared by Canadian Resourcecon Limited in 1982. In general more critical briefs were submitted by agricultural interests while forestry interests were less critical of the study.

British Columbia. Ministry of Lands, Parks and Housing. 1981. Prince George Area Crown Land Concept Plan. Victoria, British Columbia.

This document is the first step in the formulation of a Sub-District Crown Land Plan. The Plan contains a comprehensive inventory of Crown land use and resource attributes, as well as future land requirements for various settlement and resource-oriented uses. Four conceptual alternatives were provided for public interest groups and government agency evaluation; and a preferred alternative selected to guide the future management, allocation and disposition of Crown lands.

British Columbia. Ministry of Lands, Parks and Housing. 1981. Prince George Area Sub-District Crown Land Plan. Victoria, British Columbia.

Preparation of this Crown Land Plan was based upon the need to address and resolve three issues that were generated by the completion of the "Prince George Special Sales Area Study," Phase I Interim Report in 1978: 1) The need to establish the most suitable Crown land uses within "Settlement Area" designations of the Interim Report; 2) The need to resolve the basic settlement vs. forestry resource allocation conflicts within "Deferred Area" designations and identify the most appropriate use and management policies; and 3) The need to finalize the boundaries of lands identified as "Integrated" or forest management areas in the Phase I Report to facilitate development of major forest silviculture programs.

Bunce, Hubert W.F. 1983. "An Overview of Land Use Changes Related to Canada's Forest Land Base." Discussion paper prepared by Reid, Collins and Associates Ltd. for the Lands Directorate and the Canadian Forestry Service, Environment Canada. Ottawa, Ontario.

An overview study of land use change relating to Canada's forest with special emphasis on: 1) The types of land use change pertinent to the forest land base; 2) Methodologies and techniques by which these changes can be monitored; 3) Existing land use change data bases; and 4) Major areas in Canada where the forest is presently in a state of land use flux.

Burgar, R.J. 1970. "A Proposal for Wilderness Areas, Nature Reserves and Forestry in the Kenora Forest District." Forestry Chronicle. Volume 46, No. 1, pp. 56-61.

The author views a major problem in resolving the forestry, wilderness area and nature reserve conflict as the lack of definition as to how much area will be necessary to meet the future demand for each use. Using the Kenora Forest District to provide examples, guidelines for the mutual realization of the different land use goals are suggested.

Canadian Institute of Forestry. 1982. The Importance and Potential of the Timber Resource in Alberta. Rocky Mountain Section, Resource Monitoring Committee. April 1982.

Canadian Resourcecon Limited. 1982. "A Methodology for Including Economic Criteria in the Crown Land Forestry/Agriculture Allocation Process." Prepared for the Ministry of Lands, Parks and Housing. Victoria, British Columbia.

The study applies an economic methodology to supplement biophysically-based land allocation mechanisms. Forage and timber producing capabilities of soil associations were grouped into 'landscape units' for an area in the Cariboo region of British Columbia. Net economic returns from forage and timber production on a per hectare per year basis were then derived for each landscape unit.

Capel, R.E. and A.G. Teskey. 1976. Recreational Value of the Forest in Southeastern Manitoba. Northern Forest Research Centre, Canadian Forestry Service, Environment Canada. Inf. Rep. NOR-X-148.

Outdoor recreation and hunting are identified as the two major recreational uses of the forest in southeastern Manitoba. Possible changes in forest management and fire control are reviewed for implications to the area's total recreational benefits.

Clarke, C.H.D. 1965. "Wildlife Values in Forestry in Ontario." Forestry Chronicle. Volume 41, No. 2, pp. 236-244.

Describes the abandonment of the concept of single-use forestry in both Ontario legislation and planning. Examples are provided where wildlife management and forestry have impinged on each other, and the conclusion in these cases is that sound management should produce few problems. It is proposed that on non-agricultural open lands in the vicinity of metropolitan areas, wildlife management and forestry together become economical where advantage is also taken of the urgent need for open space for many forms of outdoor recreation.

Crickmer, R.E. 1981. The Role of Physical Factors in the Process of Farmland Abandonment in Nova Scotia, 1953-1974. Saint Mary's University, Atlantic Region Geographical Series Number 2. Halifax, Nova Scotia.

The objectives of this study are: 1) To examine empirically the importance of physical variables on farm land abandonment within selected parts of the province of Nova Scotia; 2) To provide a possible explanation as to why earlier geographical work on this topic has shown such widely disparate results. The relationships between farmland abandonment, its stage of development and quality of environment are found to be extremely complex. The role of physical factors in accounting for the spatial distribution of abandoned and recently cleared land varies according to the scale of observation.

Dawkins, F. 1981. "B.C.'s Crown Land Disposal Plan Attracts Barbs from All Sides." The Truck Logger, January 1981, pp. 9-12.

A review of opposition expressed by the forest industry, professional foresters and B.C. Forest Service regarding the Crown Land Disposal Program introduced in August 1980; intended to stimulate the province's agricultural industry by auctioning off sections of Crown land to B.C. residents, who are encouraged to farm it.

Environment Canada. Canadian Forestry Service. 1983. Reporting and Summarising Forest Change Data: Manitoba Pilot Study. Information Report P1-x-36 Forestry Statistics and Systems Branch, Chalk River, Ontario.

A pilot project which describes forestry change data as periodic and quantitative information on depletions and accruals to the forest resource, on those management activities undertaken to protect or enhance the resource and on changes in land ownership and status that affect harvesting of the resource. The change data elements recorded in Manitoba for the 1981-1982 operating year are presented as an example.

Environment Canada. 1983. "Federal Economic Development Strategy for New Brunswick. Environment Canada Framework Paper No. 2." International Document. Dartmouth, Nova Scotia.

This paper was prepared for use by the Federal Economic Development Coordinator in further developing an economic development strategy for New Brunswick. The paper emphasizes those aspects of Environment Canada's interests which require consideration in defining an economic strategy and in the implementation of federal programs and projects. Topics reviewed include: forest industries, water, parks and historic sites, land, weather and climate, and the general economy/environment considerations.

Environment Council of Alberta. 1979. The Environmental Effects of Forestry Operations in Alberta. Report and Recommendations. Edmonton, Alberta.

This publication was the result of public hearings held at 15 locations, primarily in or near the Green area and in the major cities of the province. Eleven information bulletins were prepared by various authors to provide focus to concerns expressed at the hearings. Although major concerns differed among the various areas of the province, one issue which arose at every hearing involved some aspect of the multiple use of forest land, its definition in time and space, the inherent conflict present in multiple-use schemes, and various solutions to these conflicts.

Framingham, C.F., et al. 1970. The Interlake Fact. Prepared and distributed by the Planning and Priorities Committee of Cabinet Secretariat, Province of Manitoba. Winnipeg, Manitoba.

This volume provides a compilation of 1968 detailed statistical data for the Interlake region. Presented in tables, the data are arranged according to four major categories: Resource Base, Resource Improvement, Resource Use and Resource Performance.

Glasgow, W.M. 1982. Fisheries and Wildlife Resources and the Agricultural Land Base in Alberta. ECA82-17/IB17. Fish and Wildlife Division, Alberta Energy and Natural Resources and Environment Council of Alberta. Edmonton, Alberta.

The purpose of this report is to discuss fish and wildlife resources that live in agricultural Alberta. Agricultural practices such as clearing, draining, cultivating, irrigating, damming water courses, pesticide spraying, fertilizing, crop harvesting and livestock grazing all modify fish and wildlife habitat to varying degrees. Techniques to overcome management problems and maintain fish and wildlife resources in agricultural Alberta are discussed.

Gordon M. 1981. Agricultural Land and Land Use Planning in Alberta: A Review of Planning Legislation and Practices. ECA81-17/IB4. Environment Council of Alberta. Edmonton, Alberta.

Reviews existing land use planning legislation and practices at all levels of government.

Hellum, A.K. 1978. "Where to Practice Forestry in Alberta?" Forestry Chronicle. Volume 54, No. 4, pp. 220-221.

This article briefly reviews changes in the status of land between (a) Public Forest, (b) Private Agricultural, and (c) Agricultural Expansion zones has resulted in a net annual loss of 130 square miles of forest land between 1951 and 1976. Average annual changes in square miles were: (c) to (b), 974; (a) to (c), 36; (c) to (a), 119; (a) to land uses other than (b) or (c), 213.

Ironside R.G. et al. (ed.). 1974. Frontier Settlement. Papers presented at an International Geographical Union Symposium held August 1972 in Edmonton and Saskatoon. Department of Geography, University of Alberta. Edmonton, Alberta.

Keating, M. 1983. "The Crisis in Our Forests." Nature Canada. Volume 12, No. 3, pp. 10-22.

The first in a four-part series, this article reviews current concerns regarding the Canadian forest land base and conflicts related to forest management.

Lamarche, E. and M. Phipps. 1982. Land Use Suitability Determination Technique. University of Moncton, Moncton, New Brunswick.

An analysis of land-use systems and environmental characteristics of the Northern Kent County, N.B. The objectives of the research were: 1) transfer to the Maritimes a technique for determining the hierarchy of constraints limiting the development of the various agricultural systems located in the study area; and 2) to apply the technique to a pilot project and thereby train local personnel in the use of the computer programs developed by M. Phipps and in the interpretation of the computer outputs.

Lamoureux, Diane. 1985. The Abandonment of Agricultural Land In Gaspé, Quebec. The Causes and the Impacts on Land Use. Working Paper No. 29. Lands Directorate, Environment Canada. Ottawa, Ontario (Forthcoming).

The postwar period has seen a major decrease in the agricultural use of the land resource in the Gaspé region. This has been accompanied by a relative decline in the services and living standards precipitating out-migration, which in turn has reduced local markets for agricultural products. The Gaspé is remote from major markets, a fact which has impeded agricultural growth, and to a lesser extent, forestry development. Much land remains in an abandoned state, the titles still held by those who have left the farming industry for other jobs in the region or elsewhere. A notable exception is the stable milk products industry of the Matapédia Valley. Government programs have been very important to the direction of change in Gaspé land use. The report reviews the role of the Bureau de l'amenagement de l'est du Québec and the Federal/Provincial regional development agreements in the use of the region's resource lands.

Lavigne, Nicole. 1985. Agricultural Land Abandonment: Renfrew Country, Ontario. Working Paper Series. Lands Directorate, Environment Canada. Ottawa, Ontario (Forthcoming).

Census figures show a large decline in the farmland area in Renfrew County over the last 20 years and earlier. Major changes in the agricultural structure of the County have produced such significant shifts and reductions in the agricultural land areas through farmland abandonment, reconversion to forestry and farm consolidation. Some of the factors responsible for this process are changes in economic conditions, evolving quality of life expectations and aging of the farm population combined with the lack of young farmers to take over. As a result, the process of farmland disappearance took place according to physical characteristics of the land, distance to markets and size of the enterprise.

Lovering, J.H. 1963. "Agricultural Land Use in the Fort Vermillion-La Crête Area of Alberta." Geographical Bulletin. No. 20, November 1963, pp. 39-57.

MacMillan, James A. and S. Lyon. n.d. The Interlake Experience: A Description and Evaluation of a Rural Development Program, 1967-1977. Occasional Series No. 9. Department of Agricultural Economics and Farm Management, Faculty of Agriculture, University of Manitoba. Winnipeg, Manitoba.

A description and evaluation of the Fund for Rural Economic Development (FRED) Agreement for the Interlake Area of Manitoba.

Mandale, Maurice. 1984. Marginal Land Utilization and Potential: Kent County, New Brunswick. Working Paper No. 31. Lands Directorate, Environment Canada. Ottawa, Ontario.

To examine the processes and consequences of farmland abandonment and related land-use change, in an area of some physical potential for agriculture; in Kent County, New Brunswick.

Mandale, Maurice. 1980. The Agricultural Industry of the Northumberland Lowland Region, Cumberland County, Nova Scotia. Prepared for the Cumberland District Planning Commission. Amherst, Nova Scotia.

An assessment of the physical and socio-economic factors influencing agricultural development in the study area, to assist in the preparation of rural plans.

Manitoba Environmental Council. 1977. Rural Land Use Conflicts: Some Solutions. Ed., William Bell and J.J. Keleher. Study 8. Winnipeg, Manitoba.

This publication represents the taped proceedings of the Manitoba Environment Council forum on Rural Land Use Conflicts. Intensifying rural land use conflicts are recognized with increasing demands for agricultural products, wildlife habitat, mineral resources, housing developments, recreational areas and forest products. Provincial, federal and European programs, policies and solutions are evaluated.

Maxwell, J.W. 1964. "Agricultural Land Utilization in the Dixonville-Fort Vermillion Area of Alberta." Geographical Bulletin. No. 21, May 1964, pp. 93-122.

Land use patterns and associated factors including microclimatic variations and distances to railhead are examined at the district level for the Dixonville-Fort Vermillion area. "The objective of the study was to determine the extent and nature of land utilization prior to the initiation of railroad operations with a view to establishing a land-use 'bench mark' against which future development might be measured." Maps compiled during this investigation are retained by the Lands Directorate in Ottawa.

McCuaig, J.D., and E.W. Manning. 1981. Agricultural Land Use Change in Canada: Process and Consequences. Land Use in Canada Series No. 21. Lands Directorate. Environment Canada.

This nationwide study examines the major agricultural land use changes between 1961 and 1976 using Census of Agriculture data aggregated for constant boundaries. Areas of agricultural advance and retreat were identified, in addition to the dynamics of land use change in a case study area, the Saugeen Valley.

McDougall, Fred W. 1983. "Forest Management in Alberta." Agriculture and Forestry Bulletin, University of Alberta. Volume 6, No. 2, pp. 8-11.

Alberta's forests are briefly described in terms of productivity, supply, utilization, and management. Other demands on forested lands including: watersheds, recreation, wildlife, grazing, and energy resources are reviewed.

McGill University. Faculty of Agriculture. 1973. "A Land Use Policy for Quebec." Summary of a series of seminars presented by students and staff in the Department of Renewable Resources. Montreal, Quebec.

J.D. Mollard and Associates Ltd. 1981. Land Use and Land Cover Research Mapping Project Based on Remotely Sensed Data - North Battleford-Lloydminster Region. Saskatchewan (Regina: Saskatchewan Urban Affairs, Regional Planning Branch).

J.D. Mollard and Associates under contract to the Regional Planning

Branch, Saskatchewan Urban Affairs, conducted a land cover research project based on remotely sensed data and air photo interpretation in the North Battleford- Lloydminster Region. The area covered by the project extends from 108°00 to 110°00 longitude and from 52°30' to approximately 53°40' latitude and includes that area studied by the CLI which is in the Saskatchewan Data Base.

New Brunswick Department of Agriculture and Rural Development. 1982. New Brunswick Department of Agriculture and Rural Development, Policy Manual. Fredericton, New Brunswick.

A descriptive inventory of the policies and programs of the Department of Agriculture and Rural Development. The objective and a brief description of each policy/program is provided.

New Brunswick. Land Use Policy Task Force. 1982. Land Use Policy: A Positive Approach. A Proposed Land Use Policy and Report. Prepared for the Cabinet Committee on Economic Development. Fredericton, New Brunswick.

The Land Use Policy Task Force was established in September 1981 to prepare a draft Land Use Policy and to make recommendations for its implementation. The policy is intended to 'provide a common framework for the Government's many and sometimes conflicting activities which affect the use of land'.

Nichols, P.C. and Associates Ltd. 1981. A Study of Economic Growth in the Lower Peace Sub-Region. Prepared for the Northern Alberta Development Council in co-operation with the North Western Regional Economic Development Council, and the Peace River Regional Planning Commission. Edmonton, Alberta.

Northern Alberta Development Council. 1978. Agriculture in Northern Alberta. Discussion Paper. Northern Alberta Development Council. Grande Prairie, Alberta.

Northland Associates Ltd. 1982. Assessment of Management Unit Boundaries and Productive Forest Land Alienations in Central Newfoundland. Report to the Department of Forest Resources and Lands, Government of Newfoundland and Labrador. St. John's, Newfoundland.

Nova Scotia. Land Use Data Issue Group. 1982. Nova Scotia Land Information Index. Published under the authority of the Nova Scotia Deputy Minister's Committee on Land Use Policy. Halifax, Nova Scotia.

This document provides an overview of available land-related information and serves as a guide to where this information can be found within the provincial government. The index is presented in three parts: 1) descriptive entries; 2) key work index; and 3) department/agency source listing.

Ontario Ministry of Agriculture and Food, Ontario Ministry of Natural Resources. 1982. The Forest Agricultural Resource Inventory in Eastern Ontario: A Land Use Inventory. Toronto, Ontario.

This inventory recorded existing forestry, agriculture, and other land uses in six Eastern Ontario counties. The inventory was designed to provide resource data upon which recommendations

would be based for the optimization of agricultural and forestry production in Eastern Ontario.

Ontario Ministry of Natural Resources. 1982. Strategic Land Use Plan. Toronto, Ontario.

In 1982, the Ministry produced three strategic land use plans (Northwestern, Northeastern, and Southern Ontario) to identify the policies and objectives of individual programs of the Ministry, and integrate these into a comprehensive conceptual land use plan to both identify and help resolve conflicting demands in the land and water base of each region. These plans also provide an overall strategy within which the District Land Use plans (released in 1983) will operate.

Ontario Ministry of Natural Resources. 1980. Guidelines for Land use Planning. Toronto, Ontario.

An outline of the Ministry's approach to land use planning including: the recognized planning principles; the planning process; and the involvement of other government agencies and the public participation in this process.

Parson, H.E. 1977. "An Investigation of the Changing Rural Economy of Gatineau County, Quebec." Canadian Geographer. Volume 21, No. 1, pp. 22-31.

Peace River Regional Planning Commission. 1982. Environmental Jurisdiction in the Peace River Region. Peace River, Alberta.

Pettapiece, W.W. and J.D. Lindsay. 1981. "Soil Resources and Agricultural Capability in Northwestern Canada." Agriculture and Forestry Bulletin, University of Alberta. Volume 4, No. 1, pp. 3-10.

This paper provides an overview of the physical setting of northwestern Canada in relation to potential agricultural development. The assessment covers physiography, materials, vegetation and soils of the region. Some assumptions are made regarding the climate of the area as it largely determines the potential of the area for agricultural development. While it is accepted that an economic analysis is required before agricultural development can be seriously considered, an evaluation of the effect of economic factors is beyond the scope of this paper.

Poole, C.F. (Chairman). 1981. Report of the Royal Commission on Forest Protection and Management. Parts I and II. St. John's, Newfoundland.

A review of the available literature and submissions made at a series of public hearings on all aspects of forest protection and management in the province of Newfoundland. Part II of the report examines the question of forest management in the province.

Price, G. 1981a. "Provincial Forests." Journal of Logging. January 1981, p. 2944.

A description of the history and designation of Provincial Forests in British Columbia. Controversy related to the designation of Provincial Forests in the Cariboo region is detailed including concerns of the Ministry of Lands, Parks and Housing.

Price, G. 1981b. "The Incredible Shrinking Forest Land Base." Journal of Logging. January 1981, pp. 2942-2992.

The article details reactions to the government calculations stated in the Ministry of Forests, Forest and Range Resource Analysis. Miscellaneous timber, park/wilderness, and agricultural alienations in British Columbia are also reviewed.

Proudfoot, V.B. and J. Wilson. 1973. "An Evaluation of Expanding Agriculture in the Saskatchewan River Delta of Northeastern Saskatchewan." Proceedings: Symposium on the Lakes of Western Canada. The University of Alberta, Edmonton, pp. 100-112.

Reed, F.L.C. and Associates Ltd. 1980. Recent Reductions in the Canadian Timber Base. Prepared for Canadian Pulp and Paper Association for the Canadian Forestry Congress. Toronto, Ontario.

Reed, F.L.C. and Associates Ltd. 1979. "Realizing the Economic Potential of Canada's Forest Resource." The Forest Chronicle, December. Vancouver, British Columbia.

Robinson, D.E. 1983. Economic Opportunities for Land Base Expansion. Presented at the 1983 Annual AIC Conference, Joint Symposium on the Nova Scotia Agricultural Land Base. Paper No. 83-315.

This study examines factors explaining the 'land scarce features' of the Nova Scotia agricultural industry in the face of the lowest ratio of agricultural land utilization to cropping capacity in the country.

Robinson, J. Lewis. 1952. "The Northern Extension of the Pioneer Fringe of Agriculture on the Great Plains of Canada." Proceedings International Geographical Union, VIIIth General Assembly - XVIIth Congress, Washington, pp. 657-662.

Romanowski, Jacek I. 1983. "Manitoba's Northern Rural Frontier." Paper currently scheduled for publication. Department of Geography, University of Manitoba. Winnipeg, Manitoba.

The northern rural frontier is depicted as a complex entity varying in space and time. Significant changes in the rural ecumene are noted which have caused the frontier today to be a very different phenomenon from what it has been in the past.

Romanowski, Jacek I. 1982. "Impact of Resource Utilization on Canada's Northern Rural Fringe." Unpublished paper presented at the IGU Commission on Rural Development, Aracaju, Brazil, August 1982. University of Manitoba. Winnipeg, Manitoba.

A review of the Canadian northern rural frontier in history; native and immigrant settlement along the fringe; resource development; and the present and the future of the modern northern rural fringe.

Ryerson, Robert A. et al. 1982. "Landsat for Monitoring Agricultural Intensification and Urbanization in Canada." Landsat for Monitoring the Changing Geography of Canada. Canada Centre for Remote Sensing (CCRS), Energy, Mines and Resource. Ottawa, Ontario.

Sadler, Heather. 1984. A Management Strategy for Agriculture at Canada's Margins M.A. Thesis. School of Urban and Regional Planning, University of Waterloo, Ontario.

Documents the recent abandonment, or underutilisation, of agricultural land in Lunenburg County and assesses the specific causes and consequences of the land use changes that have occurred.

Saskatchewan Environment. 1980. Land Use in Saskatchewan. P.C. Rump and Kent Harper. Policy, Planning and Research Branch. Regina, Saskatchewan.

This document describes the resource base and land uses in Saskatchewan by means of a text and a series of maps and statistical tables. For each major sector the pertinent legislation is outlined.

Saskatchewan Parks and Renewable Resources. 1983. Resource Lands Planning and Management Strategy. Preliminary Draft. Regina, Saskatchewan.

A general strategy for an integrated planning and management program for Crown resource lands in Saskatchewan. The strategy includes: baseline data research; policy formulation for land and associated resource management; and monitoring and update of integrated resource management strategies and guidelines.

Saskatchewan River Delta Problems, Committee on. 1972. Resources, Development and Problems of the Saskatchewan River Delta. Report No. GEN-8-1. Regina, Saskatchewan.

Prepared for the Saskatchewan Water Resources Commission, this report includes chapters on agricultural potential, forestry and outdoor recreation in the Saskatchewan River Delta area.

Saskatchewan Urban Affairs. 1982. Changes in Land Cover in the West Central Area, 1966- 1981. Regional Planning Branch, Regina, Saskatchewan.

A comparison of land cover in the Lloydminster region focusing on amounts of woodlands, grasses and rough pasture land as well as increases in improved land uses. C.L.I. data surveyed in 1966 is compared with areas of land cover surveyed under the auspices of Saskatchewan Urban Affairs in 1981.

Schori, A. 1983. Agricultural Land Potential and Availability in Nova Scotia. Presented at the 1983 Annual AIC Conference, Joint Symposium of CSSS and CSAE, Nova Scotia Agricultural College, July 12, 1983. Truro, Nova Scotia.

The potential of the agricultural land resource in Nova Scotia is considered: specifically, the physical resources including their extent and limitations for agricultural production. The availability of agricultural land is considered briefly in terms of: location; appropriate technology; tenure; and land use conflicts.

C.D. Schultz and Co. Ltd. 1973 The Environmental Effects of Timber Harvesting in the Edson and Grande Prairie Forests of Alberta. Prepared for the Alberta Department of lands and Forests. Edmonton, Alberta.

Shannon, E.N. 1974. "An Evaluation of the Physical Resources of the Meadow Lake Region." Frontier Settlement. Edited by R.G. Ironside, et al., pp. 130-149. Department of Geography, University of Alberta. Edmonton, Alberta.

Storey, Keith. 1983. "Land Use Conflicts and the Alienation of Productive Forest Lands in Newfoundland. Phase I: Review and Problem Specification." Unsolicited proposal submitted to the Canadian Forestry Service, Environment Canada.

The objective of this study is to develop a set of criteria and a procedural model to provide a basis for the resolution of land use conflicts and the alienation of productive forest lands in Newfoundland. It is hoped that the research will assist in providing the basis for a land classification system in Newfoundland. This study proposal has been approved and the contract is currently ongoing.

Swinnerton, G.S. 1982. Recreation on Agricultural Land in Alberta. ECA82-17/IB27. Environment Council of Alberta. Edmonton, Alberta.

This study examines the impact of outdoor recreation on Alberta's agricultural land base. More specifically, this report explores the types and level of interaction between recreation and agriculture with particular reference to the effect of this impact on the potential productivity of the agricultural land base.

Taylor, M.C. and K.R. Leggat. 1982. Agriculture and Public Land Management in Alberta. ECA82-17/IB23. Environment Council of Alberta. Edmonton, Alberta.

An overview of the policies and principles which govern the use of public land for agriculture in Alberta. The report also briefly discusses the possibilities of expanding the amount of public land under agricultural use, particularly in the Green (forested) Area of the province.

Thompson, P.S. 1982. Maintaining and Expanding the Agricultural Land Base in Alberta: Terms of Reference and Background Information. ECA82-17/IB18. Environmental Council of Alberta. Edmonton, Alberta.

This report outlines the terms of reference for the ECA's public hearings on the agricultural land base. Also included is a concise analysis of the factors which are contributing to a reduction (primarily from urban and related uses) and deterioration of the agricultural land base and some assessment of the potential for expanding the agricultural land base. The concluding section, The Future: A Question of Direction, contains a rough balance sheet of potential changes to the agricultural land base and describes three possible ways of approaching the questions raised by the investigation.

Thompson, P.S. 1981. The Agricultural Land Base in Alberta. ECA81-17/IB3. Environment Council of Alberta. Edmonton, Alberta.

This report explores the land base for agriculture in Alberta, and the uses to which this land base is put. for agriculture; historic and current agricultural land use; agricultural activities and products; and potential for future expansion.

Troughton, Michael J. 1983. "The Failure of Agricultural Settlement in Northern Ontario." Nordia. Volume 17, No. 1, pp. 141-151.

A review of the advance and retreat of agricultural settlement in Northern Ontario from the late 19th century to present day (1981 census). This paper is part of ongoing research into agriculture in marginal areas, specifically in connection with the I.G.U. Sub-Commission on Problems of Rural Development in Highland and High-Latitude Area.

Troughton, M.J. 1977. "Persistent Problems of Rural Development in 'Marginal Areas' of Canada." Rural Development in Highlands and High-Latitude Zones. Edited by L. Koutaniemi. Proceedings of a Symposium held August 22-28, 1977, by the International Geographical Union's Commission on Rural Development, at the University of Oulu. Oulu, Finland.

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